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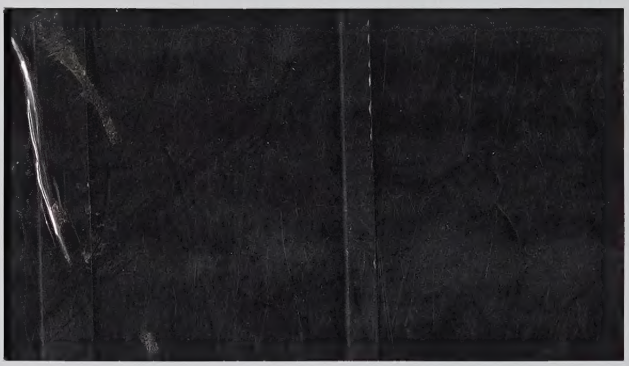

PROGRAMMABLE NOISE
GENERATING INSTRUMENT
N C 7 9 0 6
OPERATING MANUAL

NOISE COM, INC.
S/N 6492
DATE: 2/18/92

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I. GENERAL INFORMATION

1-1 INTRODUCTION

This manual is the operation and maintenance manual for Series NC7100 and NC7900 Programmable Noise Generating Instruments. It provides general information plus installation and operation instructions.

Section I provides a description and option information for the Programmable Noise Generating Instruments.

1-2 DESCRIPTION OF THE BASIC UNIT

Noise Com, Inc. Series NC7100 and NC7900 Noise Generating Instruments are designed to supply a high level of white gaussian noise output. They can be controlled manually by means of front panel controls, or, alternately, they can be controlled remotely by means of a controller via IEEE 488 (GPIB) BUS (RS-232, RS-422 or RS-423 option available). These Instruments operate remotely only in the listen mode.

The case is 17" wide, 5.25" high and 12.5" deep. It is equipped with front panel handles and fold down feet. Rack mounting brackets for 19" rack mounting are available. Brackets are mounted at the factory.

The RF circuit, without options, contains a noise generator assembly, a standby switch, and a programmable attenuator (Fig. #1). The above circuit with all options listed in the following section (1-3) is depicted in Figure #2. The digital interface for this unit, without options, is IEEE 488 BUS (GPIB).

1-3 OPTIONS AND OPTIONAL CONFIGURATIONS

Programmable Noise Generating Instrument options include:

1. Fine resolution attenuator .1db steps 0 - 127.9DB.

2. Input Power 230V 50Hz.

3. Rack Mounting Brackets (19" x 5¼").

4. Switching bandwidth by means of band limiting filters. Frequencies to be specified by customer.

   4.1 Up to 6 filters and a filter bypass for full band operation.

   4.2 7 Filters.

5. Input connector and resistive combiner. This allows a signal, externally supplied, to be combined with the noise output. Noise output will be 6DB below standard output specified.

6. The following items may be added to Item 5: Option Items 1, 4 and a 127DB, 1DB step attenuator. All of the preceeding items are programmable. These option items will be located in the input connector arm of the RF circuit.

7. The marker input option permits injection of a signal into the output line. The marker input is decoupled approximately 23DB. Decoupled noise output is available at the marker input.

II. SPECIFICATIONS

2-1 INSTRUMENT SPECIFICATIONS

Frequency Range 2KHz - 25MHz

Output impedance 75 Ohms.

Output +30 dBm

Output Connector BNC

Input voltage 115 VAC (230V 50Hz Optional).

Noise output is white gaussian noise with a qualified peak factor.

Control by means of front panel or remotely by means of a controller via IEEE (GPIB), RS-232, RS-422 or RS-423.

OUTPUT SPECIFICATIONS

NC 7900 SERIES, + 30 dBm (1 Watt) OUTPUT

MODEL	FREQUENCY RANGE	OUTPUT (dBm/Hz)	FLATNESS (dB)
NC 7903	500 Hz - 500 KHz	-27	+/-2
NC 7904	500 Hz - 1 MHz	-30	+/-2
NC 7905	500 Hz - 10 MHz	-40	+/-2
NC 7906	2 KHz - 25 MHz	-44	+/-2
NC 7907	250 KHz - 100 MHz	-50	+/-2
NC 7908	1 MHz - 200 MHz	-53	+/-2
NC 7909	1 MHz - 300 MHz	-55	+/-2
NC 7910	2 MHz - 500 MHz	-57	+/-2

OPTIONS

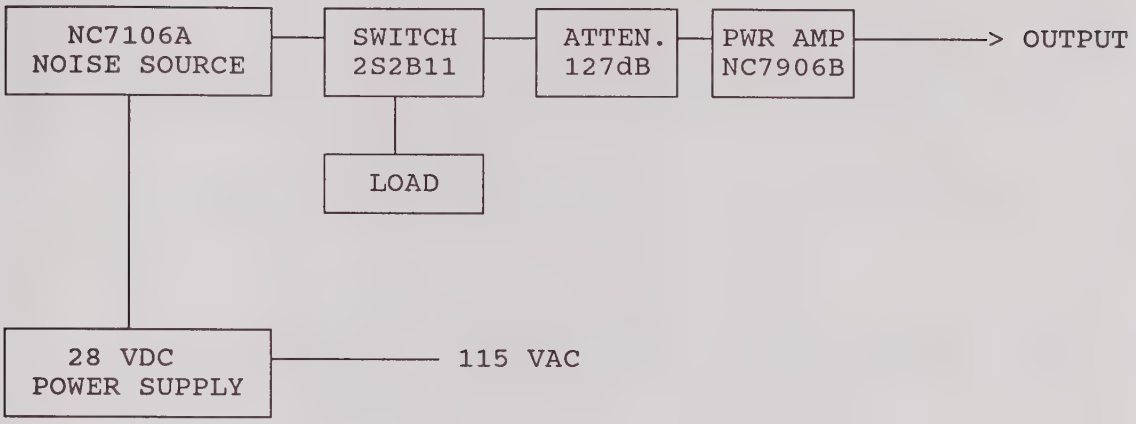
Option 1 - Output Connector N(F)
Option 2 - Output Connector BNC(F)
Option 3 - Attenuation 0 - 128 DB with 0.1 DB Increments.
Option 4 - Remote Switching to Four Filters for Sub-Bands.
Option 5 - Marker Input.
Option 6 - Output Impedance of 75 Ohms.
Option 7 - A Combiner for Input Signal.

2-2 FUNCTIONAL SPECIFICATIONS

Non Volatile memory to retain program parameters, GPIB address, serial baud rate and user programmed control sequences

Baud Rates:	300, 1200 and 9600 to be used with optional serial interface ports.
Time Delay:	.1 to 999.9 seconds with .1 second resolution.
Programmable Attenuator:	Standard 0-127DB in 1DB steps.
Programmable Attenuator:	Optional 127.9DB in 0.1DB steps.
Bandwidth selection:	Optional band switching filter to customer specification. Consult Noise Com.
Standby Position:	Power is switched into a dummy load.
Reset:	A logic reset button is provided.
Second Output:	Optional SPDB Switch to connect either of two outputs.

BOCK DIAGRAM
7906



III. INSTALLATION

3-1 INITIAL INSPECTION

Inspect the shipping container for damage. If the container is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If the instrument has been damaged in transit, notify the carrier as well as Noise Com, Inc.

3-2 GPIB (IEEE 488 BUS Interconnection)

The only interconnection required for GPIB operation is between the Programmable Noise Generating Instrument and the controller. This is accomplished by means of a standard GPIB 24 wire interface cable.

Restrictions on use of GPIB interconnections are as follows:

1. No more than 15 Instruments may be installed on the bus.

2. Total accumulative cable length in meters may not exceed two times the number of bus instruments, or, 20 meters, whichever is less.

3-3 GPIB (IEEE 488 BUS) ADDRESS

The programmable noise generating instrument as shipped from the factory is preset to address 5.

3-4 RS-232, RS-422, RS-423 INTERCONNECTION

RS-232, interconnections are made by means of a DB25S connector mounted on the rear panel. It is wired as DTE. Pin 3 is Receive, Pin 7 is Ground and Pins 4, 5 (RTS-CSD) and Pins 6, 8, 20 (DSR, DCD, DTR) are jumper connected.

Interconnections for RS-422 and RS-423 are made as follows: Use Pin 12 for positive data connection and Pin 13 for negative data connection.

IV. OPERATION

4-1 INTRODUCTION

The NOISE/COM PNGI uses a powerful single-chip microprocessor to accurately control the amplitude, bandwidth, and combining of its internal broad-band noise source and an externally applied user generated signal.

Commands to the PNGI can be entered via a front-panel telephone-type keypad. Alternately, commands can be down loaded from any computer using the GPIB (HP-IB) IEEE-488 instrumentation bus (as a talker), or by the optional RS-232, RS-422, or RS-423 adapters allowing connection to any asynchronous serial interface. A front panel numeric display and lighting status indicators give the operator visual verification of the programming process and functional state of the device.

The PNGI includes a special non volatile memory which will retain various programmed parameters after the unit has been powered-off, and restore them to the state they were in when the instrument was last used. These preserved functions include GPIB listener address, serial baud rate, and user programmed control sequences specifying attenuation levels, signal bandwidth, time delays and incremental attenuation step values.

A "Reset" button has been provided. Use of this button will return the instrument to the power turn on state. At power turn on, the programmable attenuator is at 127DB and standby is off.

To obtain output power, F10E must be entered on the keyboard. Maximum output power will then be available at the output.

4-2 FRONT PANEL CONTROLS

Programming Via the Keypad:

The PNGI can be directly programmed through the front-panel keypad (see Fig. 3) using simple data entry sequences. Internally, the PNGI may have a maximum rf circuit as follows: two identical attenuation, filtering, and standby circuits for the internally generated noise source and for an externally applied signal provided by the user. These three functions can be independently programmed for each of the two signals (see Circuit Block Diagram Fig. 2). The two circuits then combine to a single output.

Functions F1, F2 and F3 control the attenuation, increment/decrement attenuation step size and bandwidth of the noise source component of the output. Functions F5, F6 and F7 control those same functions as applied to the externally introduced signal component, programming of these parameters is accomplished as follows:

where F represents the FUNCT Key and dn represents a digit:

ATTENUATION: F1 dl d2 d3 d4 is Programmable in the Range from 0 to 127 dB in Steps of 1dB.

If you have ordered the High-Resolution Attenuation Option for the PNGI, the available range is 0 to 127.9dB in steps of 0.1dB attenuation. Maximum signal power is output when the attenuator is programmed for 0.0dB. As the attenuation level is increased, the output signal component decreases. To program or view the attenuation of the Noise Source, key-in FUNCT 1. The current value of the attenuation level will be displayed in numeric digits and the F1 indicator will be lit. To alter the current value, either:

1. Key-in the new value desired (up to the maximum) followed by ENTER. The digits will fill the display from right to left, with the right-most position representing 0.1dB.

OR

2. Press the Increment (I) or Decrement (D) key. The "Inc" or "Dec" message will show in the display, and the step value (described below) will be combined with the previous attenuation value when the command is ENTERed.

The new value will not replace the old unless ENTER is keyed. Regardless of the value displayed, the true decimal fraction will be ZERO unless the high resolution option has been installed.

STEP SIZE: F2 d1 d2 d3 d4

Step value for the above mentioned Increment (I) and Decrement (D) functions is also programmable through the keypad. To view the currently programmed step size for the noise signal attenuator, Key-in FUNCT 2. The value will be displayed and the F2 indicator will be lit. This value will be added to or subtracted from the current value each time the Inc/Dec key is pressed when in the F1 attenuator programming mode. To alter the step value, key in the desired new value followed by ENTER. The digits will be displayed as entered, but will not take effect until the ENTER key is pressed.

FILTERING: F3 dl

Filtering of the noise signal is controlled by function F3. There is an array of up to 7 filtering elements and a dummy load within the PNGI which are used to control the signal's bandwidth. The programmer can select any of the 8 positions through the keypad, up to 4 simultaneously. Filter position 1 (one) is used to connect full frequency band to the circuit. Filter position 2 (two) is used to disconnect the signal from the other processing stages by directing it to a dummy load. The specific bandwidths provided by the six other selections are tabulated in the Appendix. To view the current filter position, key-in FUNCT 3. The display will show the position Number (1:8) and the F3 indicator will be lit. To alter the position number, key-in the new value (1:8) followed by ENTER.

If, at any time during the key-in of an attenuation level, step size, or filter position, an incorrect value is typed before pressing ENTER, the CLEAR button can be used to erase the command entered thus far. Re-key the correct values and press ENTER.

If a data entry mistake is detected after the ENTER key is pressed, simply re-key the entire sequence beginning with the FUNCT key. Note: all or part of the erroneous command may have been executed before the correction is made.

Programming the attenuation, step size and filtering functions for the user supplied component of the composite output is accomplied in an identical fashion as was described for the internal noise source. The respective function codes are F5, F6 and F7.

REMOTE I/O: F4 d1 d2 d3 d4

Function F4 is used to program the PNGI to accept commands from a host computer, terminal, or automated test equipment (ATE). To view the currently programmed parameter, key-in FUNCT 4. The data will be displayed and the F4 indicator will be illuminated.

F4 values in the range 0 through 30 represent the address to which the PNGI will respond when addressed as a listener on the GPIB. Values of 300, 1200 and 9600 represent baud-rates to be used when accessing the PNGI through any of the optional RS-232/422/423 serial interface ports. In this mode, data format is asynchronous ASCII with 8 data bits, no parity, and 1 or 2 stop bits.

To alter the displayed F4 value, key-in a valid address or baud rate followed by ENTER. This new value will be placed into permanent non volatile memory and will remain there until altered, even though unit power may be interrupted.

TIME DELAY: F8 d1 d2 d3 d4

This function provides a time delay, during which previously defined sequence will remain active, before a subsequent takes effect. The duration of the delay can be programmed from 0.1 to 999.9 seconds with resolution of 0.1 second. This feature is conveniently used within a programmed sequence (described below):

SEQUENCES: PROG nl.....ENTER

Up to 4 programmed sequences of multiple functions can be stored in the PNGI's protected memory for later execution. To store such a sequence, key-in PROG followed by the selected number (1-4) of the sequence you wish to store. Follow the sequence number by the one or more functions to be executed sequentially, and terminate the group with ENTER. For example, to program sequence #1:

PROG1 F110.0 F21.5 F36 F82.5 F30 F8.5 F1I Enter

1 Would set attenuation of the noise source..10.0 dB
2 Noise attenuation step size.....1.5 dB
3 Noise filter number.....6
4 Sustain the above conditions for.....2.5 sec
5 Disconnect noise from output - Noise Filter #0
6 Sustain the disconnect for..... 0.5 sec
7 Increment the noise attenuator by step size and repeat from line 4 above until the maximum attenuation is reached, then would start again from line 1. This programmed function would continue, once triggered, until interrupted by a key-press or remote command.

Another example, programming sequence #4:

PROG4 F10 F210 F31 F51270 F610 F77 F81 F1IF5V ENTER

1 Would set Attenuation of the noise source...0 dB
2 Noise Attenuation Step Size.....1 dB
3 Noise Filter Number.....1
4 External input attenuator.....127 dB
5 External attenuator step size.....1 dB
6 External filter number.....7
7 Sustain the above conditions for.....1 sec
8 Increment the noise attenuation by step.....1 dB
9 Decrement the external input atten. by step.1 dB
and repeat from line 7 and continue until interrupted

Note that when values were entered for the attenuators (F1 and F5) and the step sizes (F2 and F6) a least-significant digit of "0" (ZERO) was appended to the values to compensate for the fractional entry position.

As a guide to determining whether a function line will loop continually, or terminate at the end of the string leaving the PNGI set to the most recently programmed values, recognize that the string will only repeat if it contains BOTH an initial attenuation level setting AND a subsequent attenuation increment or decrement command.

example: .....F1102.5.....ENTER
AND
.....F1I.....ENTER
will not repeat, but
....F1102.5.....F1I.....ENTER
WILL REPEAT

to recall and execute any one of the 4 programmed sequences, key-in:

PROG nl ENTER

without any functions specified between the sequence number and the ENTER key.

4-3 REMOTE OPERATION

REMOTE CONTROL OF THE PROGRAMMABLE NOISE GENERATOR

All of the PNGI functions programmable via the front panel keypad (with the exception of F4) may also be controlled through a remote computer, terminal, or automatic test equipment (ATE) using the GPIB or asynchronous interface option ports.

The formats for all commands are identical to the previously described keypad sequences, except that the PROGM, FUNCT, CLEAR, INC, DEC, and ENTER keys should be abbreviated by the capital ASCII characters, P, F, C, I, D, and CR (carriage return) respectively. space characters may be inserted for clarity of reading, or may be deleted to improve message throughout. When using the GPIB interface, the message may be terminated by a CR, by the EOI hardware handshake line, or both.

The PNGI, when powered on, is always ready to accept commands and data from a controlling device and respond with acceptance handshaking when required.

TRIGGERING: T d1 [d2 d3 d4 d5]

When operating the PNGI under control of a remote device, an execution trigger may be specified that will cause immediate (default) or deferred execution of the command. The values for d1 and their corresponding effects are tabulated below:

d1 = 0 := Execute immediately on CR (default)
d1 = 1 := Execute upon receipt of a GET code

The T0 or T1 code must be the first command of a multi-byte sequence, and may be optionally followed by 1 to 4 digits representing an initial time delay after which the rest of the command sequence is to be run. For example:

T1 5.5 P1 CR

would wait for a GET (group execute trigger) code as a trigger. It would then delay 5.5 seconds, after which it would recall and execute previously stored program sequence #1. Alternately, the above command sequence could have been issued as:

T1 5.5 F110 F21.5 F36 F82.5 F30 F8.5 F1I CR

While any of the PNGI functions are activated as a result of a remote command sequence, the corresponding front panel function indicator will blink at an approximately 2 cycles per second. Additionally, the display will flash if a remotely entered command sequence is still executing. This will alert users not to tamper with the front panel keys, as the PNGI may be under a current control sequence from an external device. Pressing a front panel key will interrupt any sequence in progress and seize control of the device unless the GPIB LOCAL LOCKOUT COMMAND (LLC) is issued.

SUMMARY OF PROGRAMMABLE FUNCTION CODES

F1 n1 n2 n3 n4	Noise attenuation level (Max:127.0/127.9*)
F2 d1 d2 d3 d4	Noise attenuation step size (Min:1.0/0.1*)
F3 d1	Noise filter select (range 1:6)
F4 d1 d2 d3 d4	Remote GPIB address/baud rate select
F5 d1 d2 d3 d4	External input attenuator level (Max:127/127.9*)
F6 d1 d2 d3 d4	External input attenuator step size (Min:1.0/0.1*)
F7 d1	External input filter select (Range:1:6)
F8 d1 d2 d3 d4	Time delay functions (Range:0.1:999.9 sec)
P1 through P4	Program/recall operational sequence
F78	Connects second output (#2)
Q, MTA	Remote indicator data transmission
T d1 n1 n2 n3 n4	Remote triggering mode and time delay

*Note: Requires High-Resolution Hardware Option

ADVANCED PROGRAMMING TECHNIQUES

The working buffers in read/write memory occupy two consecutive areas of 32 character capacity each (for the remote command input and the keypad command) followed by a free space of approximately 8 characters capacity. If the PNGI is to be used exclusively under remote control, the command buffer for remote input can occupy up to 72 characters (32+32+8). If remote control is not utilized, or if the amount of the command buffer used for remote commands does not exceed 32 characters, then the keypad command buffer can occupy up to 40 characters (32+8). If there is any doubt about the command buffer boundaries when both local and remote commands are being issued to the PNGI, command strings should be restricted to 32 characters per buffer. A violation of the 72nd character upper limit will cause a BUFFER ERROR MESSAGE to be displayed, and the buffer pointer to be reset to the starting position.

The 4 programmable buffers in protected memory occupy 3 contiguous areas of 32 character capacity and 1 area of 31 character capacity. If a command string has been created in the local or remote command buffer which exceeds the 32 character limit, it may be stored and recalled from the 4 protected memory buffers but the programmer must recognize that Buffer #4 has a maximum capacity of 31 characters. Buffer #3 has a capacity of 63, if allowed to spill into Buffer #4 space. Buffer #2 has a capacity in excess of 80 characters if allowed to use space for #3 and #4 as well, as does Buffer #1 which can flow into the others. Exceeding the upper limit will cause a BUFFER ERROR.

It is possible to daisy-chain command sequences to increase the effective length of command sequences. For example, consider this sequence:

COMMAND STRING	RESULT
P1...function sequence...P2 CR	Save sequence in buffer #1
P2...another sequence...P3 CR	Save sequence in buffer #2
P3...another sequence...P4 CR	Save sequence in buffer #3
P4...final sequence.....CR	Save sequence in buffer #4
P1 CR	Load buffer #1 into working Buffer & Execute. Then chain to next buffer in sequence. Execute & chain. Execute & chain.

Or consider programming the 4th entry above as:

P4...Loop back sequence...P1 CR	Performance as above, but return to Buff #1 upon completion of #4.

Or consider programming the 4th entry as:

P4...F10.....F1I.....CR	At the end of seq. #4, looping function will be recognized & seq. #4 will repeat until interrupted.

IMMEDIATE MODE NOISE ATTENUATION PROGRAMMING

If the first keystroke entered after power-on or since the last ENTER key press is "I" or "D" then that front-panel keystroke is interpreted as either "F1 I ENTER" or "F1 D ENTER" and is executed immediately, causing the F1 Function LED to be illuminated and the current noise attenuation level to be adjusted by the step value and displayed. This feature is only operable from the front-panel keypad.

The following error messages may appear on the PNGI display:

Err.	Key stroke error
Err.B	Buffer - too many characters. Reset.
Err.P	Program mode error - improper sequence.

4-4 REMOTE INDICATORS (IEEE488 BUS ONLY)

The controller may ask the programmable noise generating instrument to send remote indicator data as follows:

1. The controller should write a command string which includes the letter Q.

2. At any time after sending Q, sending MTA will cause the Instrument to send a remote indicator data string.

3. Remote indicator data will include the following string of digits separated by comma.

4 digits, noise attenuator (no decimal point) the least significant digit is the decimal digit.

4 digits, noise attenuator step size.

4 digits, noise filter switch positions actuated (position 1 noise ON, position 2 noise OFF)

4 digits, GPIB address

4 digits, input attenuator (no decimal point) the least significant digit is the decimal digit.

4 digits, input attenuator step size

4 digits, input filter switch positions actuated (position 1 noise ON, Position 2 signal OFF)

4 digits, time delay function

0,1 local lockout by controller. 1 indicating local lockout.

This data string will be followed by <CR> and <LF>

Q must be sent prior to each MTA request. The full data string will be sent after each request.

4. Power on/off. No response from noise generating instrument if power off.

NOTE: If the time delay function is activted, the controller will get no response. The instrument will again respond to inquiry when the time delay is complete.

V. PERFORMANCE VERIFICATION

5-1 TEST EQUIPMENT

Spectrum Analyzer, Hewlett Packard 853A, 8557A, 8558B.

Dynamic Signal Analyzer (FFT) Hewlett Packard 3561A.

Power Meter, Hewlett Packard 432A.

RF Voltmeter Hewlett Packard 3400A.
(True RMS Voltmeter)

Digital Plotter Hewlett Packard 7470A.

Temperature Compensated Thermistor Mount
Hewlett Packard 478A or 8478B.

Attenuator, Weinschel Engineering 4M-10dB.

Computer, Hewlett Packard Model 85B.

5-2 FREQUENCY RESPONSE

Frequency response may be verified by placing a 10dB attenuator on the output of the programmable noise instrument and viewing on a spectrum analyzer of FFT as appropriate.

5-3 POWER OUTPUT

Power output may be measured by means of a power meter and thermistor mount for frequencies above 10MHz. Below 10MHz, a true RMS voltmeter such as HP3400A with 50 ohms shunting the input, should be used.

5-4 DIGITAL FUNCTIONS

Digital functions may be verified by means of the programming instructions of section 4-3.

VI. ADJUSTMENT AND CALIBRATION

The programmable noise generating instrument should be returned to Noise Com, Inc. for adjustment and calibration.

VII. SERVICE

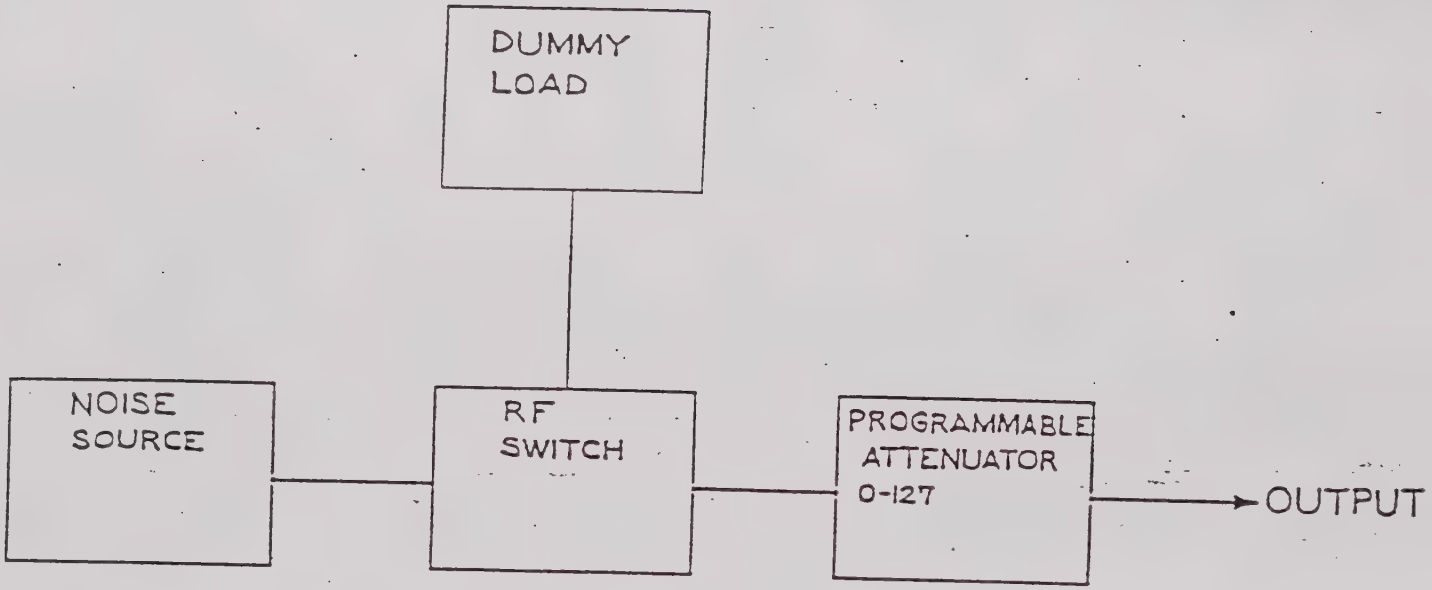
The programmable noise generating instrument should be returned to Noise Com, Inc. for service. Power schematic is shown in Figure #4.

7-1 COMMON PARTS

GPIB CONNECTOR	IEEE-488-1
FUSE	1A
FUSE HOLDER	F004-ND
POWER SUPPLY (5 VOLTS)	HB5-3
POWER SUPPLY (28 VOLTS)	HB28-2
LINE CORD	17250
DISPLAY BOARD	3.1 A/R
PROGRAMMABLE BOARD	3.1 A/R
SWITCH (ON/OFF)	31-281-025
SWITCH LENS CAP	31-963-9
SWITCH, LAMP	31-963-1
LED COVERS	4341
RESET SWITCH	19-159-015
RESET LENS	19-159-8
CABINET	R517-12
LOAD	T185M

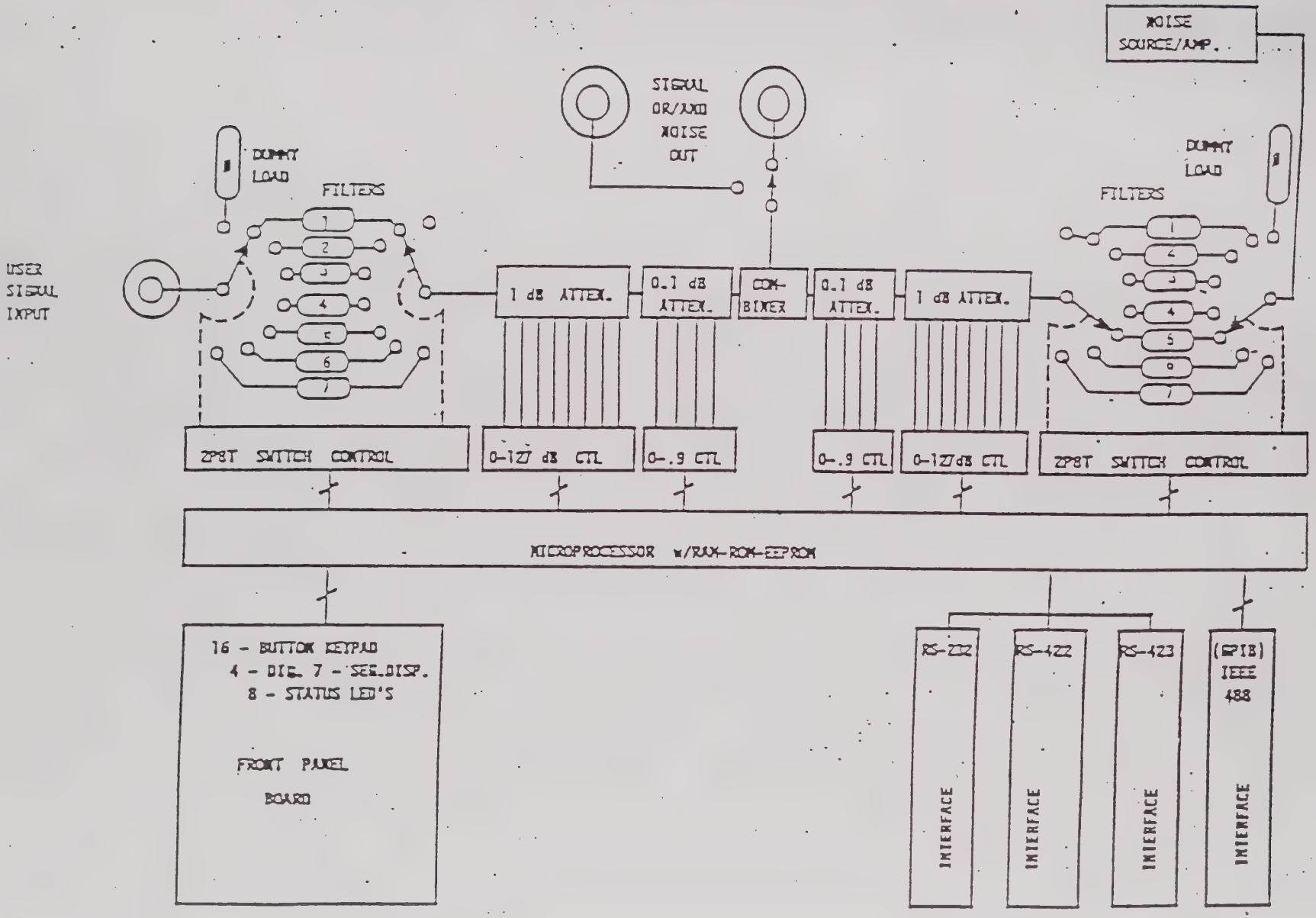
7-2 PARTS LIST

NOISE SOURCE	NC7906A
POWER AMP	NC7906B
PROGRAMMABLE ATTENUATOR (1dB)	50P-331
COAXIAL SWITCH	2S2B11
AC RECEPTACLE / EMI FILTER	3EF2F
OUTPUT CONNECTOR	BNC
POWER SUPPLY	HB-5-3.5
POWER SUPPLY	HB-28-1.0



BASIC RF CIRCUIT

FIGURE #1


NOISE SOURCE/AMP.
SIGNAL OR/AND NOISE OUT
DUMMY LOAD
FILTERS
DUMMY LOAD
FILTERS
USER SIGNAL INPUT
1 dB ATTEN.
0.1 dB ATTEN.
COM-BINER
0.1 dB ATTEN.
1 dB ATTEN.
2P8T SWITCH CONTROL
0-127 dB CTL
0-.9 CTL
0-.9 CTL
0-127dB CTL
2P8T SWITCH CONTROL
MICROPROCESSOR w/RAM-ROM-EEPROM
16 - BUTTON KEYPAD
4 - DIG. 7 - SEG. DISP.
8 - STATUS LED'S
FRONT PANEL BOARD
RS-232
RS-422
RS-423
(GPIB) IEEE 488
INTERFACE
INTERFACE
INTERFACE
INTERFACE

PROGRAMMABLE NOISE GENERATING INSTRUMENT

FRONT PANEL LAYOUT

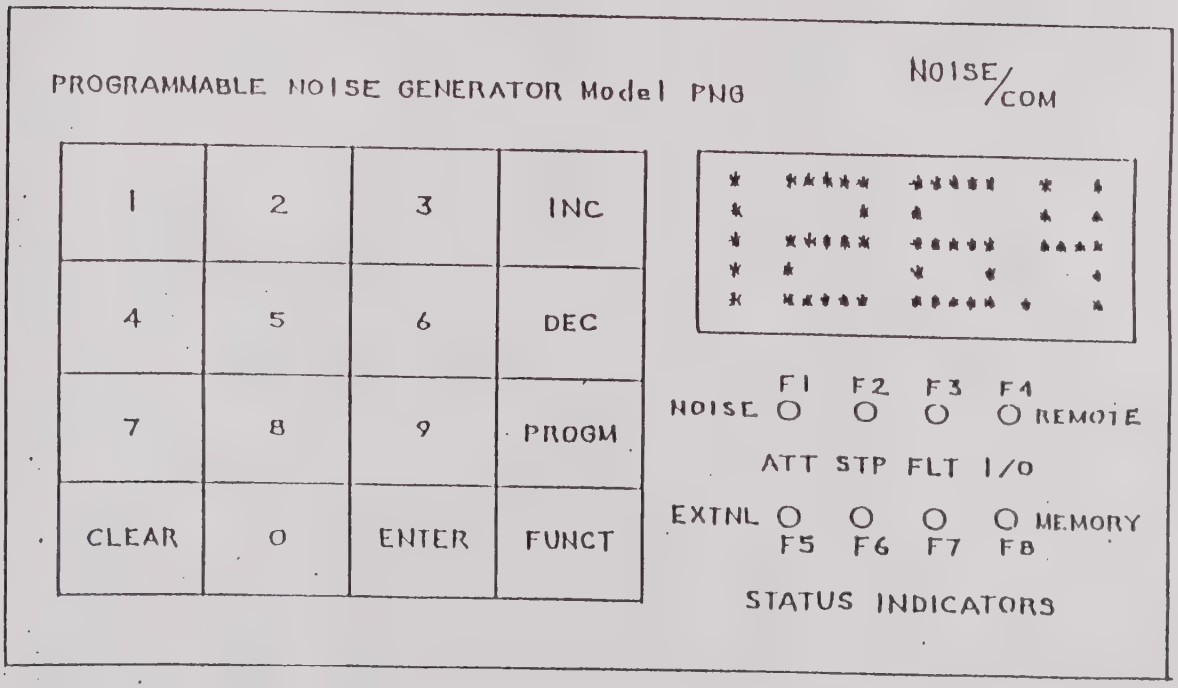
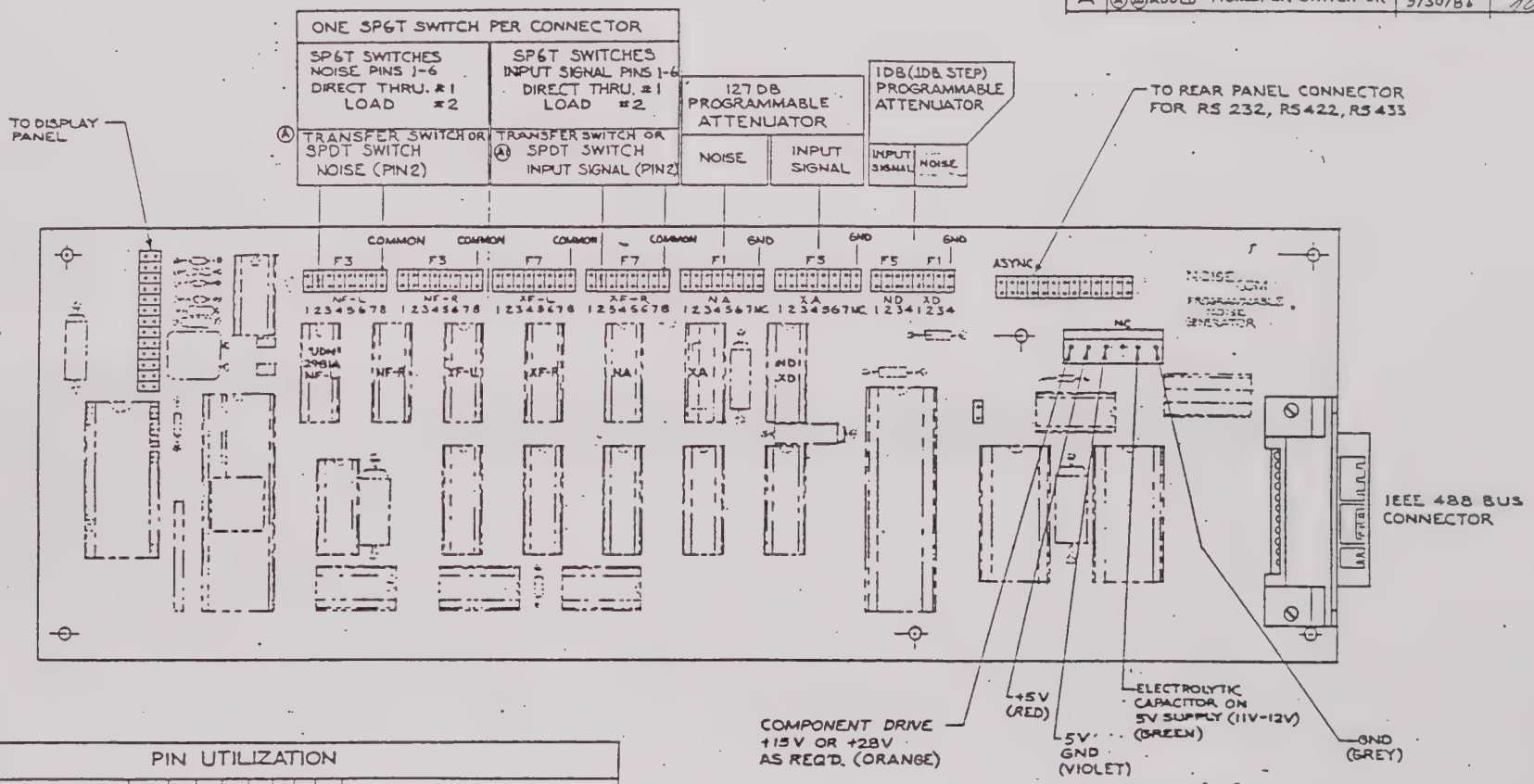


FIG. 3

DWG. NO. 11623 | SH | REV. A

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	Ⓐ Ⓐ ADDED "TRANSFER SWITCH OR"	5/30/86	



PIN UTILIZATION

PIN	1	2	3	4	5	6	7	8	
127 DB (1DB STEPS)	1	2	4	8	16	32	64	NC	
1 DB (.1DB STEPS)	.1	.2	.3	.6					(WEINSCHEL 3204-4, PN32)
SWITCH F3, F7	1	2	3	4	5	6	7	8	

NOTE: THE DUAL OUTPUT SPDT SWITCH IS ACTUATED BY POSITION. F.78 (CONNECTOR)

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± 1/64 DECIMALS XX ± .01 XXX ± .005 ANGLES ± 1/2

MATERIAL —

FINISH —

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN LEE	1/31/86
CHECKED	2/3/86
ISSUED	2/3/86

NOISE COM INC.

PROGRAMMABLE NOISE INSTRUMENT
LOGIC BOARD CONNECTIONS
NC 7100 SERIES

SIZE	FSCM NO.	DWG. NO.	REV.
B	65185	11623	A

SCALE F.S. | SHEET

BISHOP GRAPHICS, INC. RECORDER NO. 20518

NOISE COM INC.
E. 49 MIDLAND AVE.
PARAMUS, N.J. 07652
4/7/92

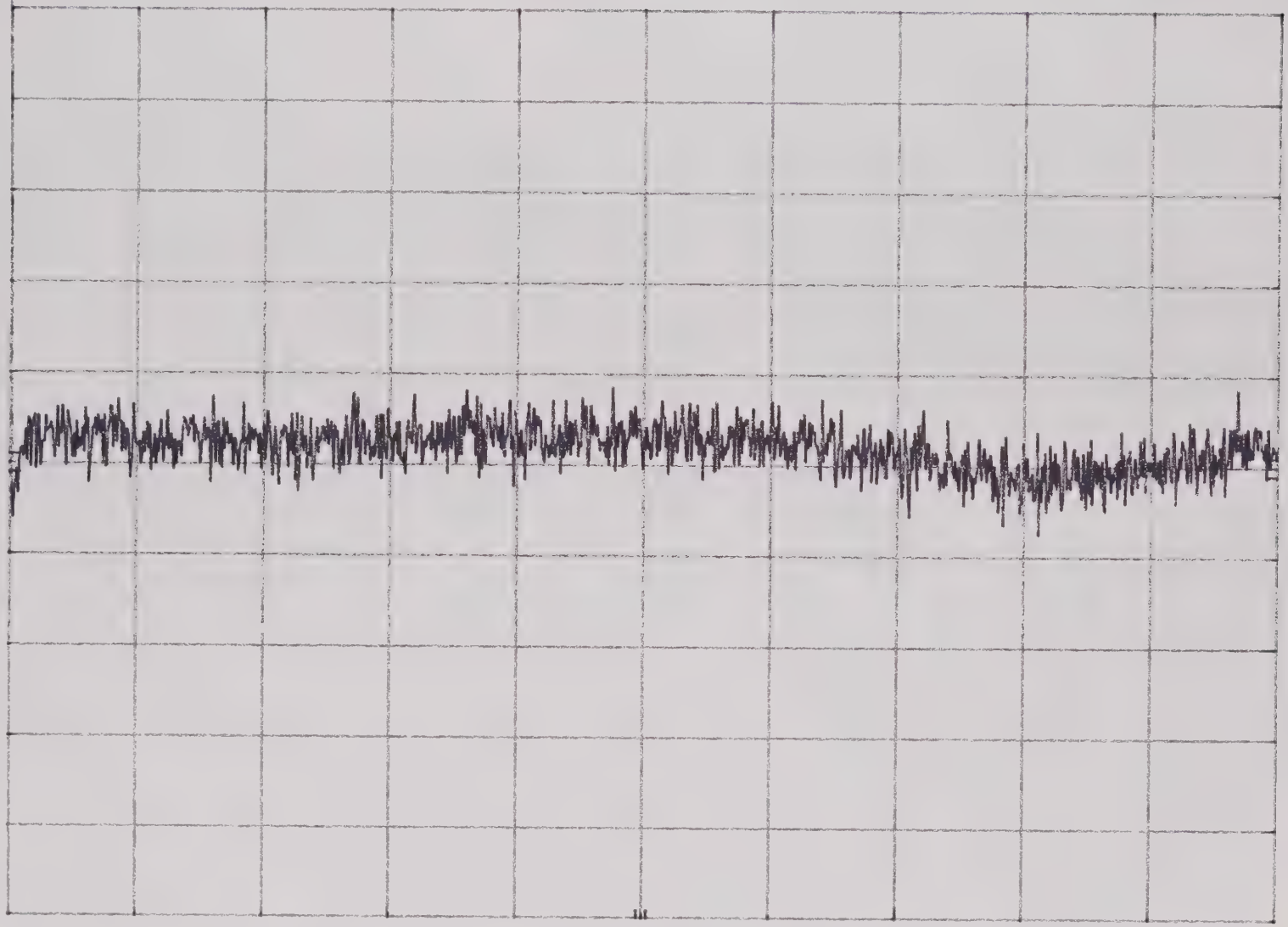
NC 7906 S/N 6492 W/26 DB PAD

hp

REF -20.1 dBm ATTEN 20 dB

2 dB/

SAMPLE



START 0 Hz STOP 25.0 MHz

RES BW 30 kHz VBW 100 Hz SWP 25.0 sec

1990 EDITION

BROADBAND NOISE SOURCE COMPONENTS & INSTRUMENTS

DC to 110 GHz

The universal test source for . . .

Noise figure
Bit-error rate
Noise-power ratio
Frequency response
Compression point
Receiver sensitivity
Interference susceptibility

FOR MILITARY, SPACE, AND COMMERCIAL APPLICATIONS

NOISE/COM

E. 64 Midland Avenue
Paramus, New Jersey 07652
Phone (201) 261-8797 • FAX (201) 261-8339

The Challenges For Noise... Noise Com Meets Them Head On

Although the uses of noise in the electronic engineering environment are generally well known, new applications are still being developed.

Designers and test technicians throughout the world are using Noise Com noise-generation equipment to evaluate the performance of military and commercial communications, radar, satellite communications, and data transmission systems.

For example, noise sources can be used to:

- Measure the susceptibility of electronic equipment to interference
- Drive broadband jammers, and simulate jamming in trainers
- Measure the bit-error rate of digital communications systems.
- Evaluate radar system performance
- Evaluate communications receiver performance
- Fault isolate failures in CATV and MATV systems
- Measure noise figure

At The Heart: A Noise Com Noise Source

The root of every Noise Com product is a diode that generates white noise. The output of this diode is well-characterized energy that maintains constant power spectral density over a specific frequency range. This property makes it extremely useful as a reference to which the performance of electronic equipment can be compared.

The diodes in Noise Com products are carefully screened from among thousands of samples. Only those diodes meeting the unique criteria for broadband noise generation are selected. These diodes are hermetically sealed, and burned-in for 168 hours to ensure reliable, repeatable performance.

Conservatively Rated Products: Fully Tested And Delivered On Time

Noise Com has established a tradition of customer loyalty by maintaining four standards:

- Attention to customer needs
- Conservatively rated products that perform as specified
- Reliability the first time out
- Unsurpassed delivery times

Noise Com products are manufactured in conformance with strict standards. Inspection is conducted on all incoming components, and every noise diode, noise source, or instrument is burned-in, and retested, to ensure compliance with specifications. Noise Com products are conservatively rated—we guarantee that each product we ship will meet its specifications.

Delivery is almost unprecedented in the industry—catalog products in 1 day, and custom designs on schedule.

If You Don't See It Ask For It

Noise Com is well acquainted with special system requirements that are often considerably different from "catalog" products. But whether the changes entail optimization of electrical performance parameters, or special packages, Noise Com can provide the answer.

We have developed a variety of noise sources, instruments, and noise subsystems to our customers' special requirements. Some of these designs include:

- Variable-frequency and variable-bandwidth subassemblies
- Waveguide noise modules to 110 GHz
- Noise source subassemblies featuring integrated amplifiers, selectable bandwidths, and a precision noise source.

When you work with Noise Com on custom component, instrument, or subsystem designs, you can be assured of receiving the special attention that has become a Noise Com trademark.

So give Noise Com your most challenging designs. And we'll give you answers — fast. Call a Noise Com representative at (201) 261-8797.

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Making The Correct Choice

A Product For Every Application

Noise Com offers noise sources for virtually every conceivable application, from self-diagnostics, to bench measurement to field performance evaluation, and electromagnetic susceptibility testing. You can choose from:

Page 5

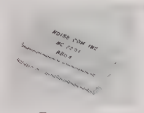
The NC 400 Series: The diodes themselves, available in several package styles and many combinations of electrical parameters up to an operating frequency of 50 GHz. These diodes can form the basic elements of noise generators for inclusion at the design stage in a wide variety of equipment.

Page 6

The NC 800 Series: Broadband noise sources in TO-8 packages for built-in test equipment (BITE). The units operate from a wide range of DC voltages. They contain a biasing network, and produce output up to -140 dBm/Hz.

Page 7

The NC 1000 Series: Noise sources integrated with RF amplifiers, which produce high-level noise output from for audio frequencies through 2 GHz, output amplitude up to +13 dBm.

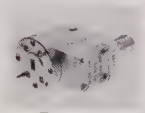


Page 8

The NC 2000 Series: Plug-in amplified noise modules housed in 14 pin or 24 pin dual-in-line packages, for operation from 50 Hz to 300 MHz, and output to +13 dBm.

Page 9

The NC 3000 Series: Calibrated broadband noise sources with coaxial connections for instrumentation and high-power applications. Operating frequencies are from 10 kHz to 26 GHz, with excess noise ratios up to 35 dB.



Page 10

The NC 5000 Series: Calibrated waveguide noise sources in standard waveguide bands from 18 GHz through 110 GHz, with excellent output flatness.

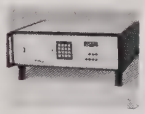
Noise On The Bench

Whether the application is in research and development, production, ATE, or quality control, Noise Com makes a noise-generating instrument that can make measurement easier, more accurate, and less expensive.

Noise Com combines its expertise in noise source design, with the additional features required in the test environment to produce low-power and high-power manual instruments, as well as fully programmable bus-controlled instruments for the ATE station:

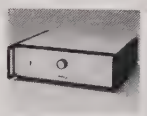
Page 11

The NC 6000 Series: Broadband instruments that include an RF amplifier, precision step attenuator, and power supply. The basic noise-generating instrument for the bench. This series produces manually controllable noise output to +13 dBm.



Page 12

The NC 7000 Series: The state of the art in noise generating instruments. Microprocessor control, digital display, full IEEE-488 compatibility, precision noise source and programmable attenuator. The NC 7900 Series features output to 1 W (+30 dBm). All are excellent choices for automated test stations.



Page 14

The NC 8000 Series: High-power (1 W), broadband instruments with precision step attenuator, RF amplifier with wide dynamic range, and highly stable noise source. The one to choose for electromagnetic compatibility (EMC) testing, as a jammer driver, in securing communications channels, and many more.

Noise: What Is It And How To Use It
Use this primer to boost your knowledge of noise and and sources. **Page 15**

Application Notes
These typical noise source applications can help you in your own designs. **Page 17**

Dimensions and Package Configurations. **Page 20**

Special Products for Special Environments. **Page 23**

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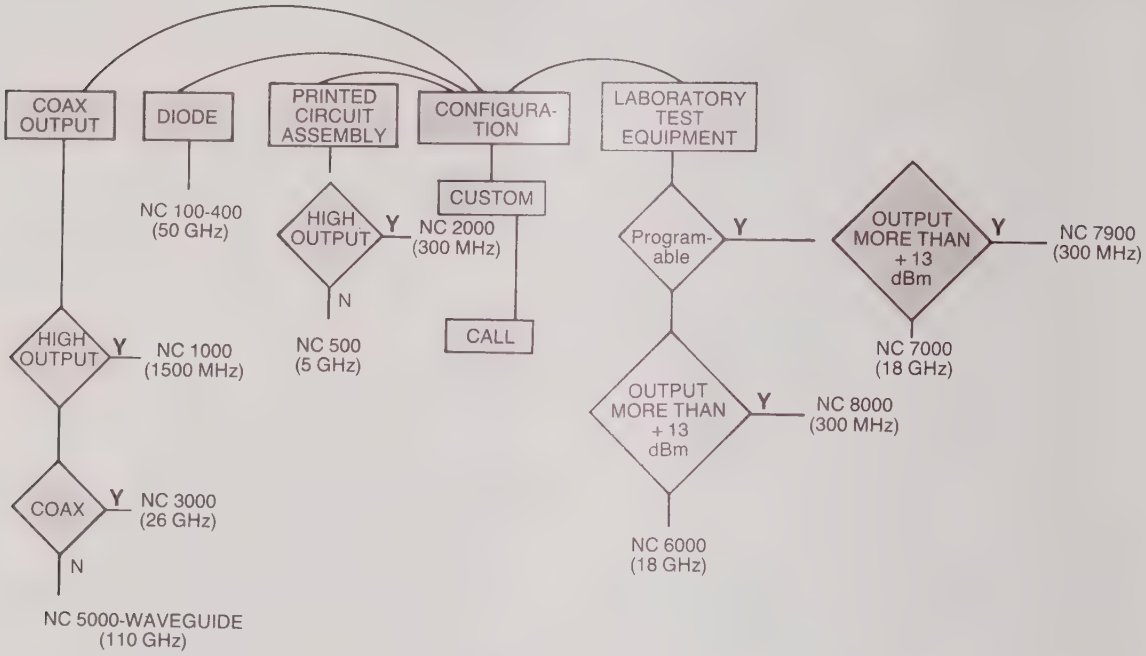
How To Specify A Noise Source



Specifying a noise source can be a simple procedure. The key is in knowing which parameters are critical in a particular application, as well as packaging and other more routine considerations.

Noise Com solid-state sources can be specified in octave or multioctave bandwidths, in various packaging configurations to suit the needs of coax, waveguide, or PC mounting. The accompanying flow chart shows the broad categories of Noise Com's catalog products. While many of the important electrical parameters such as output power, output flatness, stability, and frequency coverage can be specified from this catalog, they represent only a sampling of special requests that can be accomodated.

The frequency range of the noise source should extend beyond the limits of the operating requirements of the system it will operate in, or the unit under test, so that its band-edge performance can be evaluated. The noise source should have adequate Excess Noise Ratio (ENR) to drive test signals through the equipment after it (a measurement receiver for example).

For maximum accuracy in noise and gain measurements, the noise source should have flatness much better than that of the unit under test. Noise Com products typically have long-term stability of 0.1 dB and temperature stability of less than 0.01 dB/°C from −55 to +85°C. Variations with supply voltage are only 0.1 dB for each 1-percent change in operating voltage.

A mismatch between the source and the load will cause measurement errors. So mismatch should be reduced as much as possible. Adding attenuation to a solid-state noise source can improve matching, but output is reduced. Fortunately, Noise Com products generate noise levels high enough that the power after attenuation is sufficient (15 or 16 dB ENR) for most test applications. On and off VSWR can be lowered to less than 1.2:1 in this manner over most of the operating bandwidth, while producing acceptable output power.

Two other factors should be considered when selecting a solid-state noise source: power supply compatibility and calibration accuracy. Most units are designed to operate from between +15 and +28 VDC.

The noise sources should be calibrated at a sufficient number of points over the full bandwidth. To ensure this criterion is met, Noise Com provides calibration at selected points throughout the device bandwidth, as well as full-band calibration charts. Noise Com performs calibration using laboratory-standard sources. Calibration points are traceable to the National Bureau of Standards.

In any case where questions arise, it is important to check with Noise Com's technical staff to determine the proper noise source for the application.

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Noise Diodes

NC 100 through NC 400

10 Hz to 50 GHz

Features

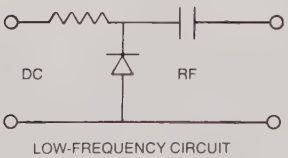
- Five package options
- Flat output
- Operating temperature −55 to +125°C
- Storage temperatures −65 to +150°C
- Meet MIL-STD-750

Noise Com's noise diodes are the fundamental building blocks of all noise systems. They are hand-picked for performance characteristics that make them ideally suited to broadband noise generation with flat response.

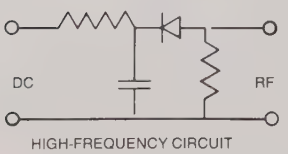
All Noise Com noise diodes deliver symmetrical white Gaussian noise with flat output with frequency. The diodes are burned-in for 168 hours, meet MIL-STD-202, and are hermetically sealed. Noise Com noise diodes are available in a wide variety of package styles, and in special configurations on request.

The NC 100 and NC 200 series diodes are designed for audio applications, and RF applications. The NC 300 and NC 400 series diodes are designed for microwave applications in which a 50-ohm impedance is required.

See page 20 for package styles and dimensions.



LOW-FREQUENCY CIRCUIT



HIGH-FREQUENCY CIRCUIT

AUDIO, VHF & UHF TYPES

MODEL	FREQUENCY RANGE	OPERATING CONDITIONS			MINIMUM OUTPUT	PACKAGE
		V_b (V)	I_{op}	$R_L(\Omega)$	(uV/√Hz)	*
NC 101	10 Hz – 100 KHz	7-10	30-60 µA	2200	3.0	DO-35
NC 102	10 Hz – 500 KHz	7-10	30-60 µA	2200	3.0	DO-35
NC 103	10 Hz – 1 MHz	7-10	30-60 µA	2200	3.0	DO-35
NC 104	10 Hz – 3 MHz	7-10	30-60 µA	2200	3.0	DO-35
NC 201	20 Hz – 10 MHz	7-10	0.2-0.5 mA	2200	0.1	DO-35
NC 202	20 Hz – 25 MHz	7-10	0.2-0.5 mA	2200	0.1	DO-35
NC 203	20 Hz – 100 MHz	7-10	0.2-0.5 mA	50	0.05	DO-35
NC 204	20 Hz – 500 MHz	13-15	1 mA	50	0.03	DO-35

*Available in DO-7 packages – Add suffix "A"

RF & MW TYPES

MODEL	FREQUENCY RANGE	OPERATING CONDITIONS			OUTPUT ENR (dB)	PACKAGE
		V_b (V)	I_{op} (mA)	$R_L(\Omega)$		
NC 301	100 Hz – 1.1 GHz	13-15	1-4	50	32-37	DO-35*
NC 302	10 MHz – 3 GHz	16-21	6	50	32-37	DO-35*
NC 303	10 MHz – 8 GHz	16-21	8	50	30-35	DO-35*
NC 304	10 MHz – 12.4 GHz	16-21	12	50	30-35	DO-35*
NC 305	10 MHz – 11 GHz	8-12	10	50	29-34	DO-35*
NC 401	1 GHz – 18 GHz	8-12	10	50	30-35	C10*
NC 403	12 GHz – 27 GHz	8-12	12	50	24-28	C50
NC 404	18 GHz – 50 GHz	8-12	10	50	20-25	C50

*Available in chip configuration – Add suffix "C"

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Drop-in Noise Modules For BITE

NC 500 Series
200 kHz to 5 GHz

- Economical solution to BITE
- Drop-in TO-8 packages
- 31 dB ENR output
- Minimum crest factor 5:1
- Operating temperature −55 to + 85°C
- Storage temperature −65 to + 175°C
- Temperature coefficient 0.01 dB/°C
- 50-ohm output impedance
- 28 VDC operation

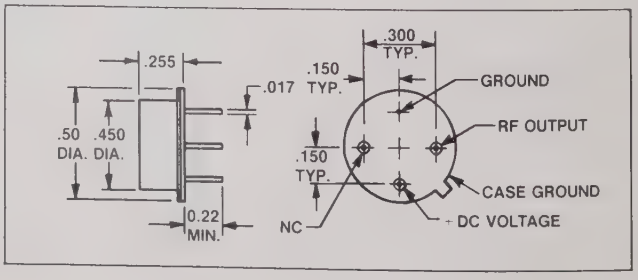
The NC 500 Series drop-in noise modules are an economical solution for built-in test requirements. They contain complete energizing circuits and need no external peripheral devices.

The NC 500 Series modules are housed in a TO-8 metal can, and require 28 VDC at 5 mA. The modules produce 31 dB ENR of white noise with a Gaussian distribution, and are available from stock in ranges to 5 GHz. Like all Noise Com products, they contain a fully characterized noise diode that has been burned-in for 168 hours.

The examples listed are representative of NC 500 Series units for typical applications. Noise Com can optimize frequency range, voltage, and output level of the NC 500 Series for specific applications.

MODEL	FREQUENCY RANGE (MHz)	MINIMUM OUTPUT ENR (dB)	FLATNESS (dB)
NC 501	0.2 – 500	31	+/– 0.5
NC 502	0.2 – 1000	31	+/– 1.0
NC 503	0.2 – 2000	31	+/– 1.5
NC 504	0.2 – 3000	31	+/– 1.5
NC 505	0.2 – 4000	31	+/– 2.0
NC 506	0.2 – 5000	31	+/– 2.5

For other frequencies, voltages and output levels, consult Noise Com.



1. + 15 VDC (Add suffix /15 after model number)
2. Military version (add suffix M)

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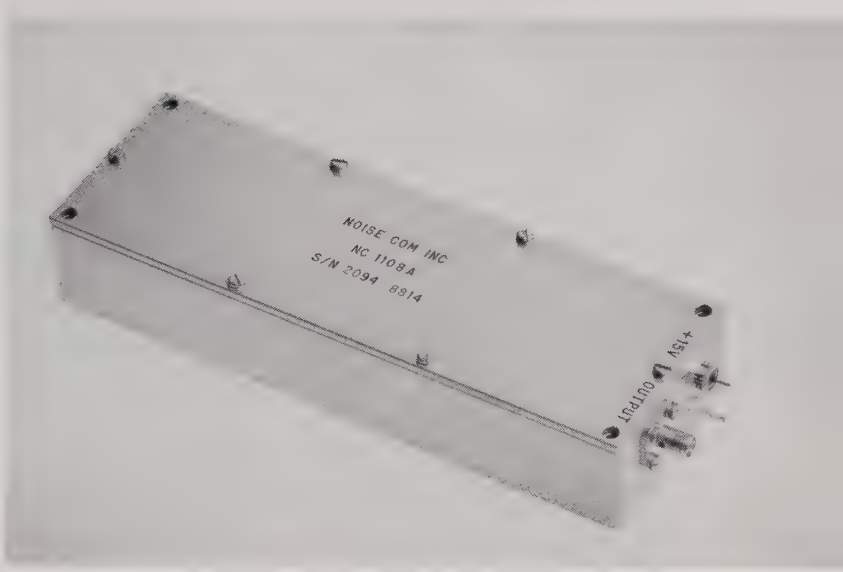
Amplified Noise Modules

NC 1000 Series

10 Hz to 1500 MHz



Features

- High power—up to 13 dBm
- Minimum crest factor 5:1
- Flat response—+/–0.75 dB
- Operating temperature –35 to +100°C
- Storage temperature –65 to +150°C
- 28 VDC operation (others available, see options)
- SMA (F) connector (others available, see options)

The NC 1000 Series amplified noise modules produce white Gaussian noise as high as +13 dBm. They are designed for applications that require injection of noise at high levels, such as testing of avionics systems, secure communications, and jamming and jamming simulators.

Each NC 1000 module contains a hermetically-packaged noise diode that has been burned-in for 168 hours. The output of the noise source is connected to a RF amplifier that boosts power to the desired output. An integral lowpass filter attenuates noise above the frequency band, providing a well-defined frequency response.

See page 21 for package styles and dimensions.

Options

1. +15 VDC
2. +24 VDC
3. BNC female connector
4. 0 dBm output (package 2)

50-ohm LOAD IMPEDANCE (PACKAGE 1)

MODEL	FREQUENCY RANGE		OUTPUT CHARACTERISTICS			
			Power (dBm)	dBm/Hz	Flatness (dB)	uV√Hz
NC 1101A	10 Hz–	20 KHz	+13	–30	+/–0.75	7071
NC 1102A	10 Hz–	100 KHz	+13	–37	+/–0.75	3162
NC 1103A	10 Hz–	500 KHz	+13	–44	+/–0.75	1414
NC 1104A	10 Hz–	1 MHz	+13	–47	+/–0.75	1000
NC 1105A	10 Hz–	10 MHz	+13	–57	+/–0.75	316
NC 1106A	100 Hz–	25 MHz	+13	–61	+/–1	200
NC 1107A	100 Hz–	100 MHz	+13	–67	+/–1	100
NC 1108A	100 Hz–	500 MHz	+10	–77	+/–1.5	31.6
NC 1109A	100 Hz–	1000 MHz	+10	–80	+/–2	22.4
NC 1110A	100 Hz–	1500 MHz	+10	–81.8	+/–2.5	18.3
NC 1111A	1 GHz–	2 GHz	–10	–100	+/–2.5	1.10
NC 1112A	20 MHz–	2 GHz	–10	–103	+/–2.5	1.55

600-ohm LOAD IMPEDANCE (PACKAGE 2)

MODEL	FREQUENCY RANGE		OUTPUT CHARACTERISTICS			
			Vrms	dBm/Hz	Flatness (dB)	uV√Hz
NC 1101B	10 Hz–	20 KHz	1.0	–40.8	+/–0.75	7071
NC 1102B	10 Hz–	100 KHz	1.0	–47.8	+/–0.75	3162
NC 1103B	10 Hz–	500 KHz	1.0	–54.8	+/–0.75	1414
NC 1104B	10 Hz–	1 MHz	1.0	–57.8	+/–0.75	1000
NC 1105B	10 Hz–	10 MHz	1.0	–67.8	+/–0.75	316

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Plug-in Amplified Noise Modules

NC 2000 Series
100 Hz to 300 MHz

- 24-pin hermetically sealed packages
- Minimum crest factor 5:1
- High-end roll off 6 dB per octave
- Operating voltage of + 15 VDC, + 12 VDC optional
- Storage temperature –65 to + 125°C
- Operating temperature –55 to + 85°C
- Temperature coefficient 0.025 dB/°C (0.05 dB/°C for NC 2111 and above)

The NC 2000 Series amplified noise modules are an excellent choice when a high-level noise output is desired, and the noise source must be mounted on a circuit board.

The NC 2000 Series modules are housed in 24-pin dual-in-line packages. Each package is hermetically sealed. Two levels of power output are available—medium power for applications to 300 MHz, and high power for audio through 500 kHz.

NC 2000 Series noise modules, with modified specificaitons, are also available in 14-pin dual-in-line packages. Consult Noise Com for availability.

See page 21 for package styles and dimensions.

).025 dB/°C)

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS				LOAD IMPEDANCE (KΩ)
		dBm/Hz	Flatness (dB)	Vrms	uV/√Hz	
NC 2101	100 Hz – 20 KHz	– 63	+/– 0.75	0.150	1061	2.2
NC 2102	100 Hz – 100 KHz	– 70			474	2.2
NC 2103	100 Hz – 500 KHz	– 77			212	2.2
NC 2104	100 Hz – 1 MHz	– 76.5			150	1.0
NC 2105	100 Hz – 10 MHz	– 86.5	+/– 1.0		47.4	1.0
NC 2106	100 Hz – 20 MHz	– 93		0.100	22.4	1.0

:0.05 dB/°C)

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS				LOAD IMPEDANCE (Ω)
		dBm/Hz	Flatness (dB)	Vrms	uV/√Hz	
NC 2111A	50 Hz– 20 KHz	–43		1.0	7071	1000
NC 2112A	50 Hz– 100 KHz	–50			3162	
NC 2113A	50 Hz– 500 KHz	–57	+/–0.75	0.5	1414	
NC 2113B	250 Hz– 500 KHz	–44	+/–0.75	0.15	1414	50

.: 0.05 dB/°C)

MODEL	FREQUENCY RANGE (MHz)	OUTPUT		LOAD IMPEDANCE Ω
		Power (dBm)	Flatness (dB)	
NC 2201	1 – 100	+5	±1	50
NC 2301	1.5 – 300	0	±1	50

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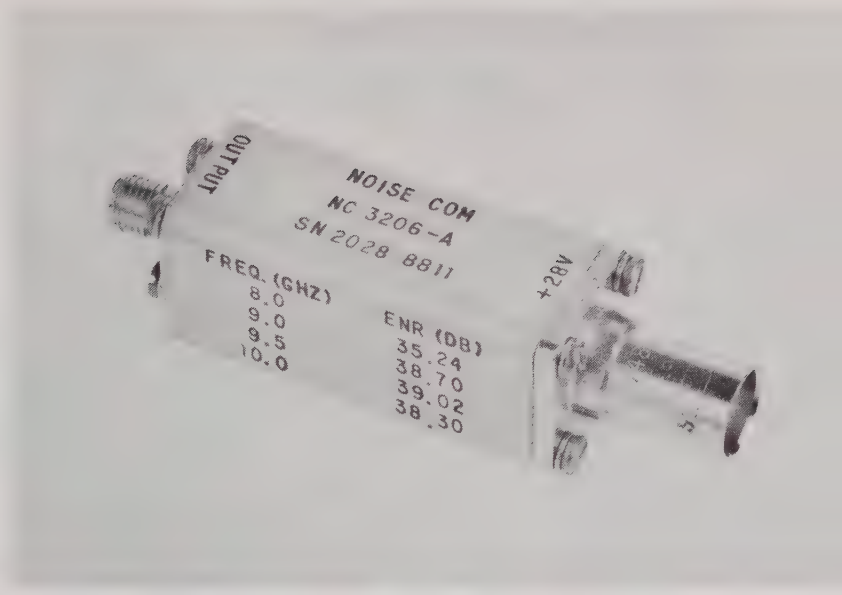
Calibrated Coaxial Noise Sources

NC 3000 Series

10 kHz to 40 GHz

Features

- Noise output rise and fall times less than 1 µs
- VSWR less than 1.35:1 for units with 15.5 dB ENR
- Noise output variation with temperature less than 0.01 dB/°C
- Noise output variation with voltage less than 0.1dB/1%ΔV
- Operating temperature range: −55 to +85°C
- Input power +28 VDC at 20 mA max.



Noise Com's NC 3000 Series calibrated noise sources embody excellent stability with temperature and voltage. They are well suited for receiver testing, noise figure measurements, and any application requiring broad bandwidth and fast switching time.

The NC 3000 Series includes the NC 3100 units, which feature 15.5-dB +/–0.5 dB ENR output for noise-figure meters, and the NC 3200 Series high-output noise sources, which feature noise output between 26 and 35 dB +/–0.5 dB ENR for radar system testing.

Like all Noise Com products, the NC 3000 Series features hermetically sealed noise diodes with 168-hour burn-in. Each noise source is supplied with calibration data for the full frequency band. Packages I and K on p. 21 are designed for severe environments such as military and space.

See page 21 for package styles and dimensions.

Options:

1. Packages A to E can be supplied with threaded mounting holes.
2. SMA connectors standard; alternate sex may be specified
3. Input voltage +15 VDC
4. +28 volts with regulation. Constant output for +/–2 V variation. Consult factory for package dimensions.

15.5 dB NOISE FIGURE METER COMPATIBLE TYPES

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (dB)	MAXIMUM ON/OFF VSWR	CALIBRATION FREQUENCIES
NC 3101	0.01 – 8	15.5 +/–0.5	1.2:1	10 MHz, 100 MHz
NC 3102	0.01 – 12.4	15.5 +/–0.5	1.2:1	1 GHz & 1 GHz steps
NC 3103	1 – 12.4	15.5 +/–0.5	1.2:1	
NC 3104	1 – 18	15.5 +/–0.5	1.35:1	1 GHz steps
NC 3105	12 – 18	15.5 +/–0.5	1.35:1	
NC 3108	0.1 – 18	15.5 +/–1.0	1.35:1	

6 dB NOISE FIGURE METER COMPATIBLE TYPES

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (dB)	MAXIMUM ON/OFF VSWR	CALIBRATION FREQUENCIES
NC 3301	0.01 – 8	6.0 +/–0.5	1.2:1	10 MHz, 100 MHz
NC 3302	0.01 – 12.4	6.0 +/–0.5	1.2:1	1 GHz & 1 GHz steps
NC 3303	1 – 12.4	6.0 +/–0.5	1.2:1	
NC 3304	1 – 18	6.0 +/–0.5	1.35:1	1 GHz steps
NC 3305	12 – 18	6.0 +/–0.5	1.35:1	
NC 3308	0.01 – 18	6.0 +/–1.0	1.35:1	

HIGH NOISE OUTPUT TYPES

MODEL	FREQUENCY RANGE	NOISE OUTPUT		CALIBRATION FREQUENCIES
		ENR (dB)	Flatness (dB)	
NC 3201	10 KHz – 1.1	30–35	+/–1	10, 100, 500, 1000 MHz
NC 3202	0.001 – 0.6	30–35	+/–1	10, 100, 500 MHz
NC 3203	1 – 2	30–35	+/–1	1, 1.5, 2 GHz
NC 3204	2 – 4	30–35	+/–1	
NC 3205	4 – 8	30–35	+/–1	
NC 3206	8 – 12	28–33	+/–1	
NC 3207	12 – 18	26–32	+/–1	1 GHz step
NC 3208	1 – 18	26–32	+/–1	
NC 3209	18 – 26	30–31	+/–1	
NC 3208S	1 – 18	30–32	+/–1	
NC 3210	12 – 40	23–25	+/–2	

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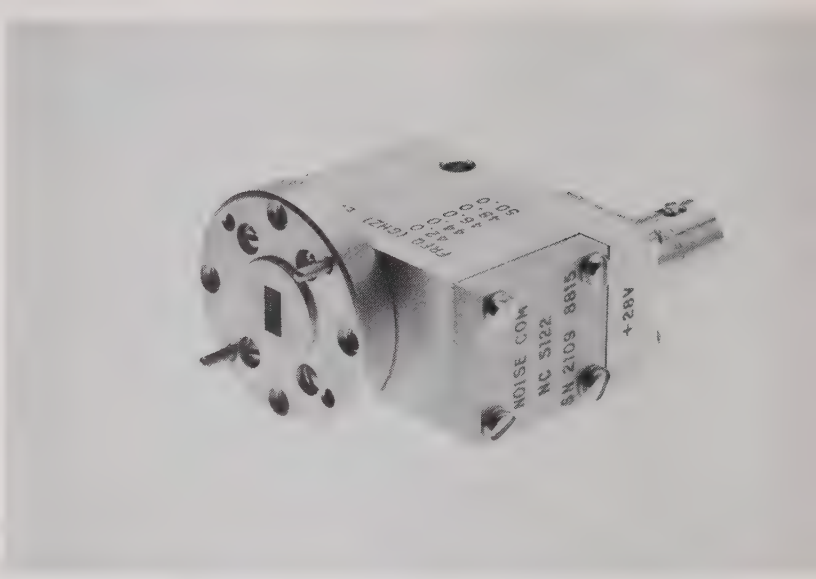
Precision Calibrated Millimeter-Wave Waveguide Noise Sources

NC 5000 Series
18 to 110 GHz

- Narrow or wideband performance with low or high output
- Noise output rise and fall times less than 1 µs
- Noise output variation with temperature less than 0.01 dB/°C
- Noise output variation with voltage less than 0.1 dB/1%ΔV
- Operating temperature −55 to +85°C
- Input power +28 VDC at 20 mA max.



The NC 5000 Series noise sources feature outstanding stability, switching speed, and ripple-free response over standard waveguide bands. Stability of the NC 5000 Series allows these units to be used in place of cumbersome gas-tube noise sources.

Ripple in the output of noise sources has a direct effect on measurement accuracy. Noise Com has tailored the response of the NC 5000 series so that flatness is constant throughout the specified frequency range. Long-term stability is better than 0.05 dB throughout a full year.

The NC 5000 Series is available with noise output of 15.5 dB for instrumentation (noise figure meter) applications, as well as in narrow and full waveguide bands with between 20 and 25 dB excess noise. The standard input bias connector is BNC female—others are available.

See page 22 for package styles and dimensions.

1. +15 VDC
2. TNC bias connector
3. Right-angle BNC connector
4. +28 volts with regulation. Constant noise output per +/−2 V variation

COMPATIBLE – FULL BAND

	MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (dB)	NOISE OUTPUT Flatness (dB)	VSWR Typical	MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
	NC 5142	18 – 26.5	15.5	+/−0.75	1.3:1	UG595/u	1 GHz steps	WR-42
	NC 5128	26.5 – 40	15.5	+/−0.75	1.3:1	UG599/u	GHz steps	WR-28
	NC 5122	33 – 50	15.5	+/−1.0	1.3:1	UG383/u	GHz steps	WR-22
	NC 5119	40 – 50	15.5	+/−1.0	1.3:1	UG383/u	1 GHz steps	WR-19
**	NC 5115	50 – 75	15.5	+/−2.0		UG385/u	1 GHz steps	WR-15
**	NC 5110	75 – 110	14.0	+/−2.0		UG387/u	1 GHz steps	WR-10

OUTPUT – FULL BAND

	MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (dB)	NOISE OUTPUT Flatness (dB)	MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
	NC 5242	18 – 26.5	25.0	+/−1	UG595/u	1 GHz steps	WR-42
	NC 5228	26.5 – 40	23.0	+/−2	UG599/u	1 GHz steps	WR-28
	NC 5222	33 – 50	21.0	+/−2	UG383/u	1 GHz steps	WR-22
**	NC 5219	40 – 60	21.0	+/−2	UG383/u	1 GHz steps	WR-19
**	NC 5215	50 – 75	17.0	+/−2	UG385/u	1 GHz steps	WR-15

OUTPUT – NARROW BAND

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (dB)	NOISE OUTPUT Flatness (dB)	MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
NC 5342	18 – 26.5*	25	+/−0.5	UG595/u		WR-42
NC 5328	26.5 – 40*	23	+/−0.5	UG599/u	Minimum	WR-28
NC 5322	33 – 50*	21	+/−0.5	UG383/u		WR-22
NC 5442	19.9 – 23.1*	25	+/−0.6	UG595/u	Center	WR-42
NC 5319	40 – 60*	20	+/−0.5	UG383/u		WR-19
NC 5315	50 – 75*	17	+/−0.7	UG385/u	Maximum	WR-15
NC 5310	75 – 110*	15	+/−0.7	UG387/u		WR-10

* Bandwidths of one GHz may be specified anywhere in the band. Other bandwidths may be specified, however, wider bandwidths may result in a different flatness specification.
** Reduced bandwidth, consult Noise Com.

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Broadband Noise-Generating Instruments

NC 6000 Series
10 Hz to 18 GHz

Features

- Rugged design
- Precision attenuator
- Crest factor 5:1
- Excellent flatness

The NC 6000 Series are rugged noise generating instruments designed for applications on the test bench, or in test stations in which an NC 6000 Series unit is incorporated with other equipment to provide a wide variety of functions.

Each NC 6000 instrument contains a Noise Com precision noise source that delivers repeatable, white Gaussian noise. The noise source is integrated with an amplifier, 10-dB attenuator with 1-dB steps, and power supply. The NC 6000 Series has a 50-ohm output impedance, and the NC 6000B Series has 600-ohm impedance.

The units measure 8.5 in. wide by 5 in. high by 12.25 in. deep. Power requirements are 115 VAC, 60 Hz, at 500 mA. Operating temperature range is from –10 to +60°C, and VSWR is less than 2:1. Standard output connector is SMA; others are available.

50-ohm LOAD IMPEDANCE

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dB)	uV/√Hz
NC 6101	10 Hz– 20 KHz	+13	–30	+/–0.75	7071
NC 6102	10 Hz– 100 KHz	+13	–37	+/–0.75	3162
NC 6103	10 Hz– 500 KHz	+13	–44	+/–0.75	1414
NC 6104	10 Hz– 1 MHz	+13	–47	+/–0.75	1000
NC 6105	10 Hz– 10 MHz	+13	–57	+/–0.75	316
NC 6106	100 Hz– 25 MHz	+13	–61	+/–1.0	200
NC 6107	100 Hz– 100 MHz	+13	–67	+/–0.5	100
NC 6108	100 Hz– 500 MHz	+10	–77	+/–1.0	31.6
NC 6109	100 Hz– 1000 MHz	+10	–80	+/–1.0	22.4
NC 6110	100 Hz– 1500 MHz	+10	–82	+/–2.0	18.3
NC 6111	1 GHz– 2 GHz	+10	–80	+/–2.5	22.4
NC 6112	1 MHz– 2 GHz	+ 0	–93	+/–2.5	5.0
NC 6218	2 GHz– 18 GHz	–20	–122	+/–3.0	–

600-ohm LOAD IMPEDANCE

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Vrms	dBm/Hz	Flatness (dB)	uV/√Hz
NC 6101B	10 Hz – 20 KHz	1	– 30	+/– 0.75	7071
NC 6102B	10 Hz – 100 KHz	1	– 37	+/– 0.75	3162
NC 6103B	10 Hz – 500 KHz	1	– 44	+/– 0.75	1414
NC 6104B	10 Hz – 1 MHz	1	– 47	+/– 0.75	1000
NC 6105B	10 Hz – 10 MHz	1	– 57	+/– 0.75	316

Options

1. 100-dB attenuator in 10-dB steps
2. 110-dB attenuator in 1-dB steps
3. Line power 230 VAC, 50 Hz
4. Combiner for input signal
5. Marker input
6. Rack mounting
7. N female output connector
8. BNC female output connector

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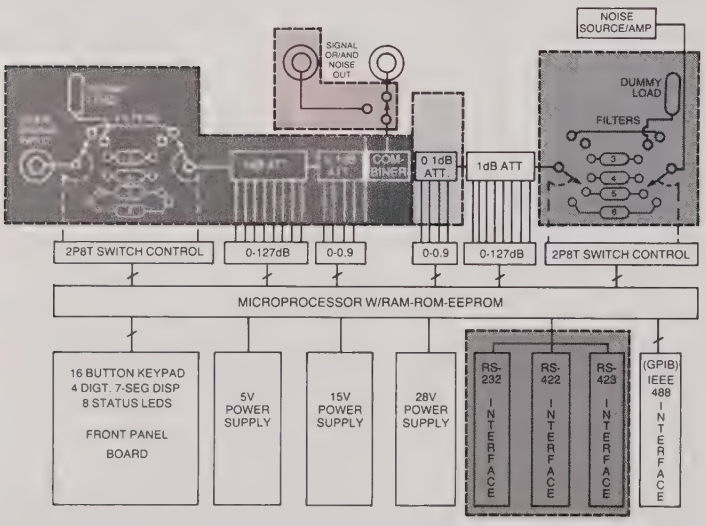
Programmable Broadband Noise-generating Instruments

NC 7000 Series

10 Hz to 18 GHz

- Completely programmable—from front panel or IEEE-488 bus
- Non-volatile memory for measurement parameters
- Front panel display
- Fast-switching 127-dB attenuator
- True white Gaussian noise output



Option 3

Option 4

Option 7

Option 8

Option 9

Option 11

The NC 7000 Series represents the state of the art in noise-generating equipment. These versatile instruments can be used alone to perform a programmed series of noise measurements, or they can be bus-controlled, for running a battery of tests automatically via any instrument controller.

The NC 7000 Series incorporates all of the benefits of Noise Com's manual noise-generating instruments, as well as advanced features that allow the instruments to function as part of large, automated test equipment (ATE) environments.

Technical description

The NC 7000 contains a hermetically sealed Noise Com solid-state noise source that is customized to deliver excellent performance over a broad bandwidth. RF amplifiers boost power output to levels high enough to satisfy virtually any noise-measurement criteria.

The amplifiers are optimized to provide an unsaturated output with a Gaussian amplitude distribution. The thick-film programmable attenuator has a switching speed of 5 ms.

The noise output state is controlled by an RF switch: In the standby state, the noise is terminated into an RF load, and in the on-state is directed to the output connector.

Operation

The NC 7000 Series is completely micro-processor controlled, and provides information on operation of the instrument through an LED display. All front-panel operations but power on/off are programmable. When controlled from the front panel, the micro-processor monitors inputs selected from the keypad, and the results are shown on the display. The instruments function as listeners when connected to the control bus. This bus can be either the standard IEEE-488 (GPIB), and/or optional RS-232, RS-423, or MATE (CIIL) protocol. A non-volatile memory stores up to four sets of up to 32 measurement parameters.

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The NC 7000 is supplied with a 127-dB attenuator with 1-dB steps. Power output is +13 dBm, or +30 dBm for the NC 7900 Series. VSWR is less than 2:1 at 50 ohms. Crest factor is 5:1, and temperature coefficient is 0.01 dB/°C. The instruments will operate from –10 to +65°C, draw 2 A from 115 VAC or 1 A from 220 VAC, and measure 5.25 in. high by 13 in. deep by 19 in. wide. They are designed to be used either on the bench, or rack mounted.

Options:

1. N female output connector
2. BNC female output connector
3. 0 to 128 dB attenuation in 0.1 dB increments
4. Remote switching to four filters for sub-bands
5. Marker input
6. 75-ohm output impedance
7. Combiner for input signal
8. Double output terminals
9. Special configurations
10. Line power 230 VAC, 50 Hz
11. RS-232, RS-422, RS-423

NC 7100, NC 7200 SERIES

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dBm)	uV/√Hz
NC 7101	10 Hz – 20 KHz	+13	–30	+/–.75	7071
NC 7102	10 Hz – 100 KHz	+13	–37	+/–.75	3162
NC 7103	10 Hz – 500 KHz	+13	–44	+/–.75	1414
NC 7104	10 Hz – 1 MHz	+13	–47	+/–.75	1000
NC 7105	10 Hz – 10 MHz	+13	–57	+/–.75	316
NC 7106	100 Hz – 25 MHz	+13	–61	+/–1.0	200
NC 7107	100 Hz – 100 MHz	+13	–67	+/–1.0	100
NC 7108	100 Hz – 500 MHz	+10	–77	+/–1.5	31.6
NC 7109	100 Hz – 1000 MHz	+10	–80	+/–2.0	22.4
NC 7110	100 Hz – 1500 MHz	+10	–82	+/–2.5	18.3
NC 7111	1 GHz – 2 GHz	+10	–80	+/–2.5	22.4
NC 7112	1 MHz – 2 GHz	+ 0	–93	+/–2.5	5.0
NC 7218	2 GHz – 18 GHz	–20	–122	+/–3.0	–

NC 7900 SERIES, +30 dBm (1 Watt) OUTPUT

MODEL	FREQUENCY RANGE	OUTPUT (dBm/Hz)	FLATNESS (dB)
NC 7903	500 Hz – 500 KHz	–27	+/–2
NC 7904	500 Hz – 1 MHz	–30	+/–2
NC 7905	500 Hz – 10 MHz	–40	+/–2
NC 7906	2 KHz – 25 MHz	–44	+/–2
NC 7907	250 KHz – 100 MHz	–50	+/–2
NC 7908	1 MHz – 200 MHz	–53	+/–2
NC 7909	1 MHz – 300 MHz	–55	+/–2
NC 7910	2 MHz – 500 MHz	–57	+/–2

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High-power, Broadband Noise-generating Instruments

NC 8000 Series
500 Hz to 300 MHz

- High power—up to 1 W (30 dBm)
- Uniform response— + /–2 dB
- Precision attenuator—100 dB in 10-dB steps (10 dB in 1-dB steps optional)
- Can be configured for custom requirements

The NC 8000 Series offers 1 W (+ 30 dBm) power output for applications in which a broadband, high power noise signal is required.

The NC 8000 Series instruments find application in electromagnetic compatibility testing, broadband jamming, jamming simulators, providing secure communications channels, and any other area requiring high-level noise.

Each NC 8000 instrument contains a Noise Com precision noise source, high-power RF amplifier with flat gain response, 100-dB attenuator with 10-dB steps, and power supply.

The NC 8000 Series has 50-ohm noise output, requires 115-VAC, 60-Hz at 2 A, and operates from –10 to + 60°C. The units measure 17 in. wide by 5.25 in. high by 13 in. deep, and are available for rack mounting.

The NC 8000 Series boasts the features of all Noise Com instruments, including rugged construction, repeatable performance, and excellent electrical characteristics. They can be configured for a wide variety of custom applications. Specifications that can be varied include output power, flatness, and attenuation.

NC 8000 SERIES

MODEL	FREQUENCY RANGE			OUTPUT (dBm/Hz)	FLATNESS (dB)
NC 8103	500 Hz	–	500 KHz	–27	+/–2
NC 8104	500 Hz	–	1 MHz	–30	+/–2
NC 8105	500 Hz	–	10 MHz	–40	+/–2
NC 8106	2 KHz	–	25 MHz	–44	+/–2
NC 8107	250 KHz	–	100 MHz	–50	+/–2
NC 8108	1 MHz	–	200 MHz	–53	+/–2
NC 8109	1 MHz	–	300 MHz	–55	+/–2
NC 8110	2 MHz	–	500 MHz	–57	+/–2

1. 10-dB attenuator in 1-dB steps
2. 110-dB attenuator in 1-dB steps
3. Line power 230 VAC, 50 Hz

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NOISE: What It Is And How To Use It

Noise plays an important role in the RF and microwave environment because it is virtually a universal test signal.

Noise can be used to characterize both components and systems, and can be applied to a variety of measurement applications. It is used to evaluate the performance of secure communications systems, for EMI testing, as a source for Built-in Test Equipment (BITE), and for telecommunications system testing.

Noise can also be used in military jamming systems to confuse an enemy radar or communications system, and in threat-simulation systems to imitate signals from enemy electronic systems. A noise signal can be generated at any range of RF, microwave, or millimeter-wave frequencies with either tubes or semiconductors.

What Is Noise?

Noise comes in many forms. They include:

- Pink noise: Features constant output per octave.
- White noise: Also called thermal noise, which contains constant power spectral density over frequency.
- Impulse noise: Intermittent, short-duration bursts that contain energy over a very broad portion of the spectrum.
- Crosstalk: Leakage signals between transmission lines caused by their proximity.
- Man-made noise: Caused mostly by electric motors, neon signs, and power lines. It tends to decrease in amplitude as frequency increases.
- Quantization noise: Caused by sampling amplitude errors in digitizing systems.
- Receiver noise: Additive noise of a receiving system that prevents the reception of very weak signals.

Noise can also be a limiting factor on component and system performance. In a spectrum analyzer, for example, noise limits the sensitivity of the instrument—that is, the lowest-amplitude signal that the analyzer can detect and display. Likewise, in a radar, noise can obscure returns from an enemy target, and limit the effective range of the radar. In digital communications, excessive noise can cause a high Bit-Error Rate (BER), resulting in the transmission and reception of false information.

In all three cases where noise was shown as a limiting factor, noise can also serve to improve performance. By using noise as a test signal, these systems can be evaluated for dynamic range and sensitivity, and tuned for maximum performance.

Noise Parameters Defined

White noise is produced by random fluctuations of electrons traveling through a resistor, and the power and amplitude of the noise (noise power) is proportional to the temperature of the resistor. Noise sources are used to produce noise levels above thermal noise.

Since white noise can be readily generated and controlled, it is the type most desired for testing. The power spectral density of white noise is constant over frequency. This implies that noise power is proportional to bandwidth. So, if the measurement bandwidth is doubled, the detected noise power will double (an increase of 3 dB). Noise voltage increases as the square root of bandwidth. For this reason, noise is usually described in dBm/Hz or V $\sqrt{\text{Hz}}$. White noise has a Gaussian amplitude distribution, and is defined by:

$$P_N = kTB$$

where P_N is the noise power available at the output of the thermal source, k is Boltzmann's constant, T is the absolute temperature, B is the noise bandwidth.

Another important parameter is noise factor, which is the measure of the additive noise produced by a receiving system. It is defined as:

$$\text{Noise factor: } \frac{\text{Signal-to-noise ratio at input}}{\text{Signal-to-noise ratio at output}}$$

The noise factor of cascaded components is calculated according to:

$$F_{AB} = F_A + \frac{F_B - 1}{G_A}$$

This can be extended to more than two devices by:

$$F_{A...N} = F_A + \frac{F_B - 1}{G_A} + \frac{F_C - 1}{G_A G_B} + \ldots \frac{F_N - 1}{G_A G_B \ldots G_N - 1}$$

Perhaps the most widely measured noise parameter is noise figure. It is defined as 10 × log (noise factor). An ideal receiver would be capable

EXCESS NOISE RATIO ENR (dB)	EQUIVALENT NOISE TEMPERATURE (°K)	NOISE BANDWIDTH 1 MHz		MICROVOLTS	
		POWER dBm	POWER MW	50 OHMS	600 OHMS
-10	319.0	-113.57	4.40×10^{-12}	0.469	1.6
- 5	381.7	-112.78	5.27×10^{-12}	0.513	1.8
0	580.0	-110.97	8.00×10^{-12}	0.633	2.2
5	1207.1	-107.78	1.67×10^{-11}	0.913	3.2
10	3190.0	-103.57	4.40×10^{-11}	1.48	5.1
15	9460.6	- 98.83	1.31×10^{-10}	2.56	8.9
20	29290	- 93.97	4.04×10^{-10}	4.49	15.6
30	290290	- 83.97	4.00×10^{-9}	14.14	49.0
40	2,900,290	- 73.97	4.00×10^{-8}	44.73	155.0
50	29,000,290	- 63.97	4.00×10^{-7}	141.42	490.0

of detecting a signal at –174 dBm at room temperature, and would therefore have no additive noise. Its noise figure would therefore be 0 dB. It is usually desirable to maintain the lowest possible noise figure so that the transmitted power can be minimized.

Noise figure and effective input noise temperature are measured by applying two known levels of noise to the input of the equipment under test and measuring the ratio of the resulting noise powers at the output of the unit under test (Fig. 1).

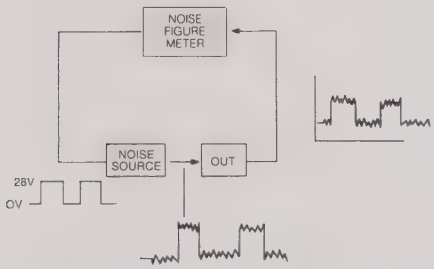

Fig. 1

This ratio is commonly referred to as the Y-factor method. It is used with calibrated input noise levels to calculate noise figure or effective input noise temperature by using the following equations:

$$F = \frac{\left(\frac{T_H}{290} - 1\right) - Y\left(\frac{T_C}{290} - 1\right)}{Y - 1}$$

$$T_E = \frac{T_H - YT_C}{Y - 1}$$

where T_H and T_C are the equivalent thermal output noise temperatures of the noise source when it is hot and cold, respectively, and T_E is the effective input noise temperature.

Excess noise ratio is the ratio of the output noise power relative to thermal noise of the termination at 290 K: It is given by:

$$ENR\ (dB) = 10 \times \log \frac{T_1 - T_O}{T_O}$$

where T_1 is the effective noise temperature of the energized noise source, and T_O is the reference termination at 290 K.

Another term used in band-limited systems is noise bandwidth: the noise power that would be transmitted in an equivalent rectangular filter. Since frequency components beyond the 3 dB points of a realizable filter add to the energy within the passband, the apparent bandwidth is larger than the 3 dB bandwidth. The difference between the noise bandwidth and the 3 dB bandwidth varies with the passband shape and skirt selectivity.

The Solid-State Advantage

Most modern noise measurements are performed with one of two noise sources: the gas-discharge tube and the solid-state noise source.
Gas-discharge tubes require a power supply of several thousand volts to ionize the gas within the tube. Once ionized, 100 to 300 VDC is required to sustain the noise discharge at the optimum current. Diodes operating in the avalanche mode are the elements in solid-state noise sources that are commonly used for noise generation.

The switching speed of the semiconductor diodes used in noise sources allows these units to be switched on and off very quickly. As a result, they are an excellent choice for synchronous radar noise monitoring which requires the measurement to be made during radar dead time, which usually amounts to only microseconds. For such applications, the noise source should have good transient response, with output rise/fall times of less than 1 µs. Diodes also require a few milliamperes of current—not 100 to 200 mA like gas-tube types, so power supplies can be smaller.

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Built-in Noise Sources Enhance Receiver Testing

White-noise generators that are included in the design of receivers can accomplish many tasks including Built-in Test (BIT) Fault Isolation Test (FIT), and calibration. The sources can be fitted into small standard packages such as TO-8s or 14-pin DIPs, and provide extremely flat spectral density and good temperature stability over very broad frequency ranges.

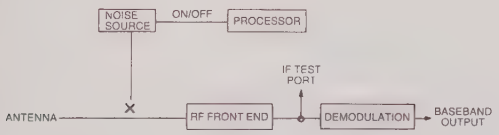

Fig. 1

A noise source integrated into a receiver to provide BIT and calibration capabilities is shown in Fig. 1. Since the output amplitude of the noise source is very stable, the receiver gain may be set to provide optimum performance. The detected output can be used to set squelch levels, or in the case of digitizing receivers, the gain can be set to trigger a desired quantization level at the A/D converters. For radar receivers, the noise source can simulate ground clutter to set the receiver sensitivity for an acceptable false-alarm rate. Built-in tests that may be performed include:

- Measurement of minimum detectable signal (receiver threshold)
- Dynamic range (threshold to saturation)
- Go/no-go testing based on signal throughput

Frequency response can be measured at a test port prior to the demodulation circuitry. Since the noise source provides constant energy across the entire operating band, the receiver frequency response can be observed instantaneously and without tuning an input signal.

Bandwidth, sensitivity, passband ripple, and spurious responses can be measured simultaneously. Frequency conversions make these measurements very difficult with a network analyzer, yet have no effect on the characteristics of the noise.

Noise sources integrated into receiver systems have enhanced performance and simplified BIT circuitry—yet they are small and inexpensive. Their characteristic of constant spectral density over very wide bandwidths makes them an indispensable addition to the system, improving its ability to be tested and repaired.

For more information on built-in testing, contact a Noise Com technical representative.

Noise Sources Function As Effective ECM Tools

Electronic countermeasures (ECM) has evolved from the need to prevent undesired communications, tracking, and eavesdropping. As communications and radar equipment have increased in sophistication, so too has ECM equipment. When specific information is known about the transmitter's characteristics, the ECM system can be tailored to most effectively interrupt reception of the signal.

But in many cases, the transmitter characteristics are not well known, or the transmitter employs techniques to avoid being jammed—counter-countermeasures (ECCM). These techniques include frequency-hopping, multiphase modulation, spread-spectrum, monopulse transmission, and the ability to detect the presence of jamming.

Noise is probably the most effective method of jamming an unknown type of signal. Noise is

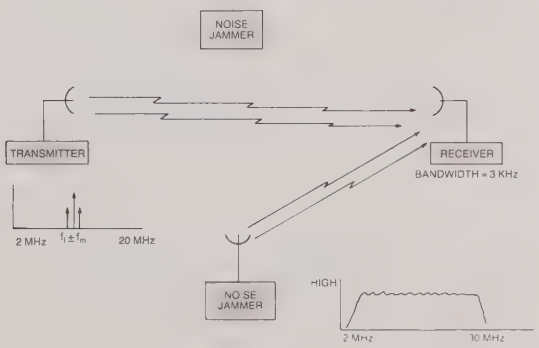

Fig. 2

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also one of the simplest and least expensive signal types to generate. A simple communications jammer is depicted in Fig. 2. The communications equipment is operating at an unknown frequency and may be frequency-hopping during transmission.

The noise jammer is able to prevent reception by generating energy at all frequencies simultaneously. By injecting noise power (which is greater than the transmitted signal) into the receiver bandwidth, the transmission is prevented. Since the noise characteristic is nearly identical to thermal noise, the receiver will not detect any coherent signals to indicate that it is being jammed.

The limitation of the noise jammer is the amount of power it is capable of radiating. Since the total radiated power is proportional to bandwidth, the power spectral density is limited by the output capability of the system's amplifiers. For example, suppose the radio to be jammed is operating somewhere in the HF region (2 to 30 MHz). The receiver detection bandwidth may be only 3 kHz. If the jammer is transmitting a total of 1 kW over the entire band, the effective power will be:

$$\text{Effective power} = \frac{3\ \text{kHz}}{28\ \text{MHz}} \times 1\ \text{kW} = 0.107\text{W} = +20.3\ \text{dBm}.$$

Obviously, if the operating bandwidth of the jammer can be reduced, its effectiveness will increase.

Fig. 3

With some added capability, the noise jammer can prevent eavesdropping while allowing the desired communications to occur. In Fig. 3, a noise jammer is illustrated that generates a noise spot with a narrow notch within the noise. The transmitter is tuned into the notch, which permits reception of the signal. The transmitter and the noise source may be frequency-hopped synchronously for added immunity.

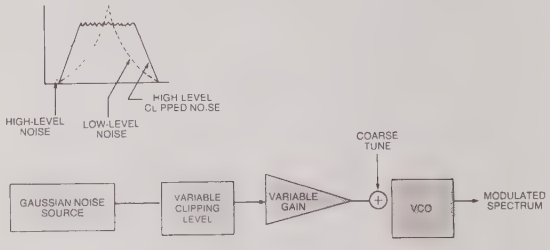

Fig. 4

ECM systems to counter radar are probably the most sophisticated. These systems are capable of detecting a radar signal, analyzing it in real time, and emitting a jamming signal that deceives the radar. A method of utilizing noise is shown in Fig. 4. The ECM system contains an exciter unit that generates the signals used to mask the radar.

The noise barrage is used to mask the radar return over a wide frequency band. The barrage is generated by modulating a voltage-controlled oscillator that is tuned to the radar operating band. The resulting spectrum can be modified to most efficiently occupy the frequency band by varying the noise amplitude and peak to RMS ratio.

Thermal noise has a Gaussian voltage distribution so that the peak voltage is typically greater than five times the RMS value. By clipping the peaks, energy is transferred to the higher frequency components. This creates a near rectangular spectrum of the VCO output, confining most of the generated energy to the band of interest. Since the spectrum still maintains its randomness, it is not easily detectable by the radar as a jamming signal.

For more information on noise sources in the ECM environment, contact a Noise Com technical representative.

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Noise Sources Enhance The Capabilities Of Automated Test Equipment

Automated test systems employ many devices that provide stimulus, signal capture, analysis, and data formatting. A programmable noise source is one type of stimulus that can provide valuable information for an almost endless array of devices.

A noise source can provide frequency response characteristics for any two-port device, even if the Device Under Test (DUT) has a frequency conversion. It also may be used to measure noise figure, noise bandwidth, compression point, signal isolation, crosstalk, carrier-to-noise ratio, EMI susceptibility, and to simulate atmospheric noise.

A programmable noise instrument may be controlled via the computer interface bus (usually IEEE-488), or manually from the front panel. Functions that may be controlled are amplitude and bandwidth. The noise source provides an output that is very flat over the desired frequency band.

By injecting a two-port device with white noise and observing the output on a spectrum analyzer, the entire frequency response can be seen—including flatness, insertion loss or gain, sensitivity, and bandwidth. By observing the device's output with a power meter, the compression point can be found. The noise bandwidth can also be measured, since noise power is proportional to bandwidth.

Noise is useful for predicting receiver sensitivity. Noise figure may be calculated using one of two methods. The first method uses a noise source with a known Excess Noise Ratio (ENR). The on/off ratio at the input is compared to the output ratio to arrive at the noise factor according to the following equation:

$$\text{Noise factor} = \frac{\text{SNR at intput}}{\text{SNR at output}}$$

$$\text{Noise figure} = 10 \times \log (\text{noise factor})$$

A similar method is performed by applying an input level that produces a 3-dB increase in the detected output. This sets the output "signal" to noise ratio to 1 and is defined as the minimum detectable signal (MDS). The noise figure is then calculated as follows:

$$\text{MDS} = \text{Thermal noise} + \text{noise figure} + 10 \times \log (\text{det BW})$$

$$\text{Noise figure} = \text{MDS} + 174\ \text{dBm/Hz} - 10 \times \log (\text{det BW})$$

Since electronic equipment must operate in the presence of environmental noise, the noise source is useful in simulating operating conditions. Test signals may be combined with the noise output. The carrier-to-noise ratio can be varied and the receiving system's response measured. This is particularly useful in simulating high background noise or jamming.

EMI testing is another area in which noise is frequently used. Crosstalk susceptibility, power-line isolation, and grounding effectiveness in digital and analog systems can be evaluated using noise sources by stimulating areas that are likely to be "transmitters" and observing the behavior of the areas that are expected to be "receivers". The broadband nature of the noise can quickly pinpoint the frequencies that will cause problems.

For more information on noise sources in ATE, contact a Noise Com technical representative.

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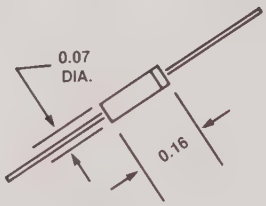
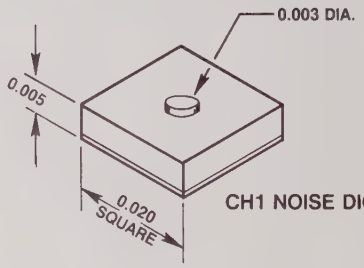
Dimensions and Package Configurations

The dimensions shown here are for standard Noise Com products. They represent the range of standard products, but do not take into consideration the specific requirements of custom systems.

For custom designs, the package style, the type and location of connectors, and various other considerations can be modified to accept the physical restrictions dictated by the design.



DO-35



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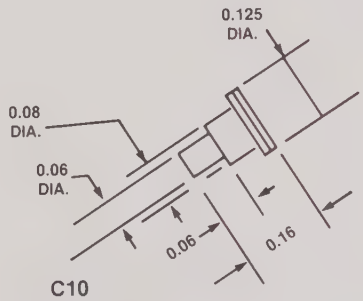
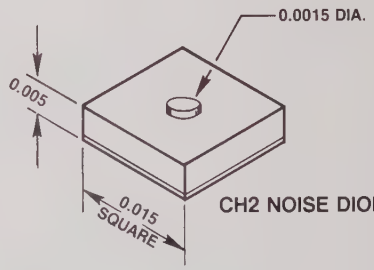
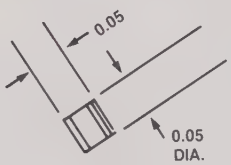


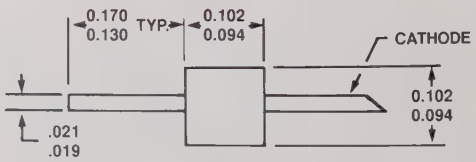
C10

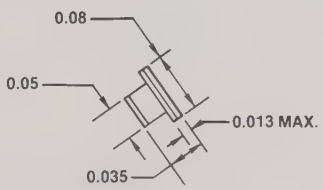


CH2 NOISE DIODE CHIP



C-50





C50H

PACKAGE BL

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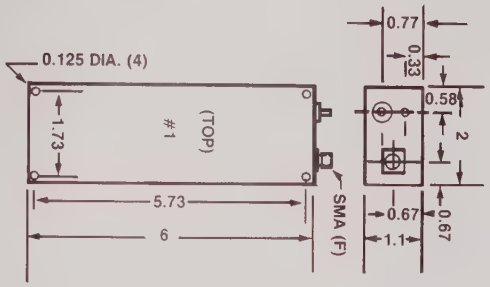
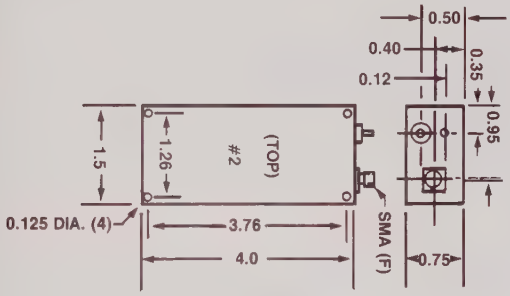
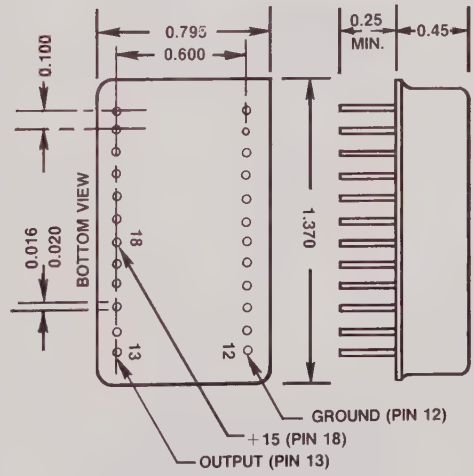
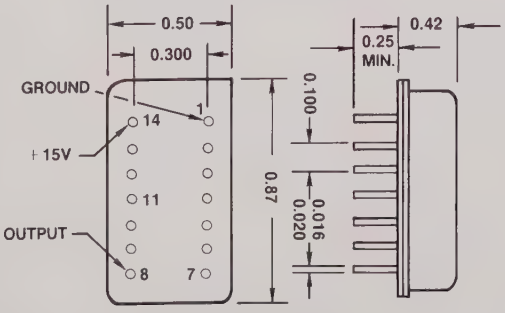


PACKAGE 1

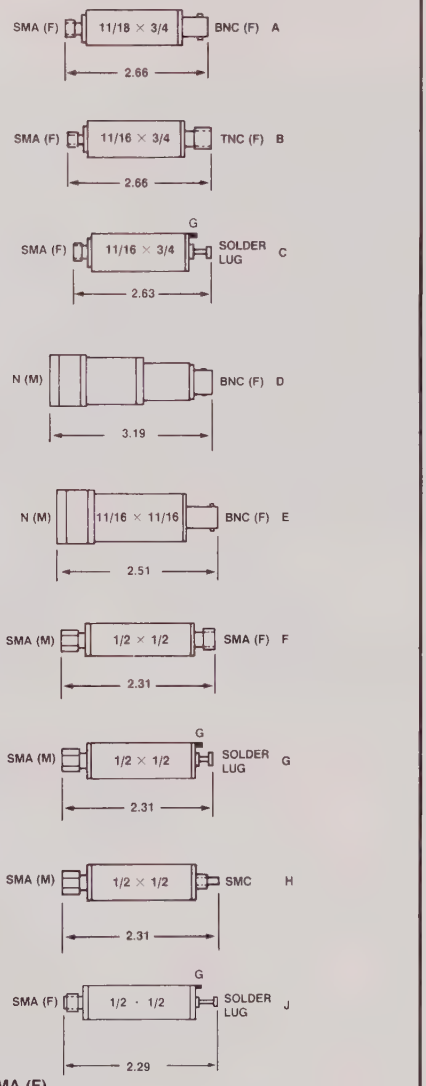


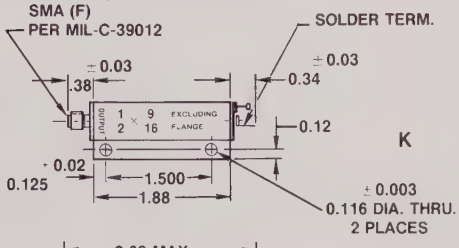
PACKAGE 2

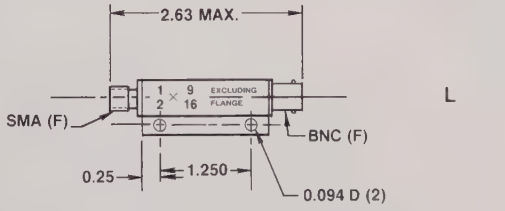




RF CONNECTOR | BIAS CONNECTOR | PACKAGE CODE







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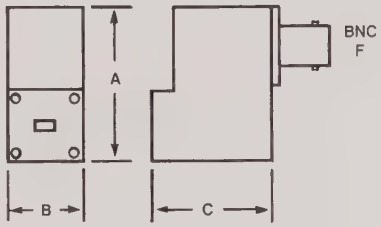
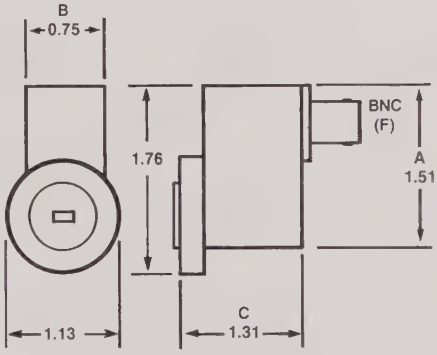
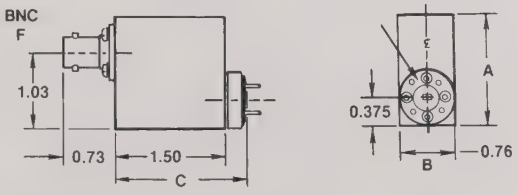
Dimensions and Package Configurations



WAVEGUIDE	A	B	C
WR-42	1.72	0.88	1.55
WR-28	1.58	0.75	1.30



WAVEGUIDE	A	B	C
WR-22	1.51	0.75	1.31
WR-19	1.51	0.75	1.31



WAVEGUIDE	A	B	C
WR-15	1.50	0.76	2.00
WR-10	1.50	0.76	1.75

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Special Products for Special Environments

The products in this catalog represent a broad range of capabilities, but they only begin to describe Noise Com's expertise in developing custom solutions to difficult design challenges.

This custom capability begins with . . .

- Combinations of different connectors
- Choice of operating voltages
- Modified electrical performance
- Custom packaging

. . . and continues to integration of noise components in sophisticated subassemblies. Noise Com has designed and constructed fast-switching, frequency-hopping noise generators, extremely stable noise generating subsystems, frequency-agile jammers, and secure communication subsystems.

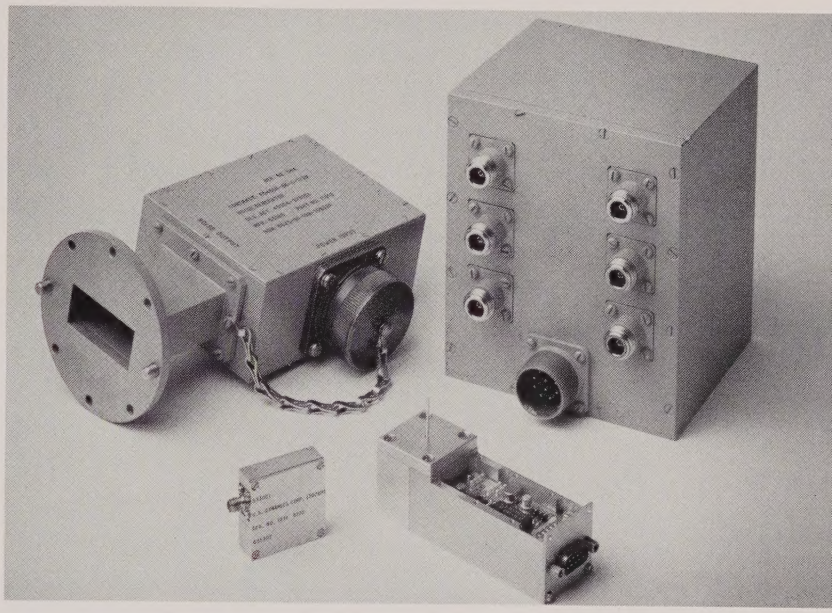
We know the systems business.

Noise Com can deliver complex noise subassemblies because we understand the systems business. The Noise Com design team has expertise in a broad area of military and commercial systems, including radar, EW, mobile radio, high-volume production, ATE, ASW, and spacecraft imaging and communications. It gives Noise Com a depth of understanding that only experience can provide.

Noise Com also benefits from our NCI Division, which designs custom digitally tuned oscillators and synthesizers, as well as custom subassembies.

Together, Noise Com and NCI provide fast solutions to some of the toughest challenges in high-frequency design. And we do it fast and within budget. It's made Noise Com a leader in noise technology.

And it can help you. Contact a Noise Com technical representative at (201) 261-8797 with your design challenge.



Some of Noise Com's Custom Subsystems

- A temperature-compensated programmable noise generator for modulation of VCOs and digitally tuned oscillators. The compact unit delivers a clipped output level (8 bit binary to +/−10 V) from 10 Hz to 10 MHz in four steps. Response time is 200 ns, flatness is +/−0.5 dB, residual FM is 100 μV, maximum DC offset is 100 μV, and the summing input is external signal plus noise. The unit measures only 5 × 6 × 2 in.
- RF instruments for NPR measurements
- Noise sources with multiple outputs
- Integrated noise source and switch assembly, packaged in a 24-pin DIP, with on/off times of 20 ns from 10 Hz to 100 KHz.
- Space-qualified noise sources
- High-power (100-W CW) noise generators with variable frequency and bandwidth
- Low-frequency noise source with low-pass filter bank, and adjustable power and clipping level

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Certification

Noise Com, Inc. certifies that its products meet published specifications at the time of shipment from the factory. Noise Com, Inc. further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty and Assistance

All Noise Com products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. Noise Com will, at its option, repair or replace products that prove to be defective during the warranty period, provided they are returned to Noise Com, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NOISE COM IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

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